UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH ADMINISTRATION

BUREAU OF ANIMAL INDUSTRY
COOPERATING WITH
UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF INDIAN AFFAIRS
AND THE
NEW MEXICO AGRICULTURAL EXPERIMENT STATION

THIRTEENTH ANNUAL REPORT OF THE SOUTHWESTERN RANGE AND SHEEP BREEDING LABORATORY FORT WINGATE, NEW MEXICO

OCTOBER 31, 1949

THIS REPORT OF RESEARCH PROJECTS NOT YET COMPLETED IS INTENDED FOR THE USE OF ADMINISTRATIVE LEADERS AND WORKERS IN THIS OR RELATED FIELDS OF RESEARCH, AND NOT FOR GENERAL DISTRIBUTION.

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ROSTER OF PERSONNEL

Name	Title	Date entered on duty	Duties
James O. Grandstaff	Animal Husbandman	Jan. 13, 1944	Director
John V. Christensen*	Animal Fiber Tech.	Feb. 3, 1947	Wool Tech.
Glenn J. Spaulding	Animal Fiber Tech.	Aug. 1, 1949	Wool Tech
George M. Sidwell	Animal Husbandman	Dec. 1, 1946	Genetics
Donald A. Price	Animal Husbandman	Mar. 21, 1949	Sheep Investigations
Johnnie P. Sinclair**	Animal Husbandman	Oct. 19, 1948	Sheep Investigations
Orval LeRoy Navarre	Stockman	Feb. 6, 1947	Sheep Management
Araminta D. Costello	Clerk-Stenographer	July 1, 1947	Clerical
Jimmie Gleason	Janitor	Apr. 1, 1942	Janitor and Maintenance
Marion Chadacloi	Agricultural Aid	Jan. 12, 1944	Miscellaneous
Alfred Dempsey	Laboratory Aid	Dec. 23, 1947	Miscellaneous
Fred Deschene	Agricultural Aid	Oct. 2, 1947	Miscellaneous

*Transferred from BAI to Navajo Service, Window Rock, Arizona, April 2, 1949.
**Resigned December 13, 1948.

OBJECTIVE

The main objective of this laboratory is the development of types of sheep which are adapted to the range conditions of the southwest, and to the economic requirements of Navajo Indians and other sheepmen of this area. In the pursuit of this objective, basic breeding methods are employed, utility values of the wool with respect to hand weaving are studied, and the selection of breeding animals is based upon production as measured under range environment. Emphasis is placed primarily on adaptability and longevity of the sheep, yield of wool and its suitability with respect to hand weaving and commercial manufacture, and the quantity and quality of lambs produced.

OUTLINE OF RESEARCH PROGRAM

Under Special Research Project SRF-2-2 entitled "The development of breeds and strains of sheep suitable to southwestern ranges and to the economic requirements of the sheepmen", there are five active research line projects.

Active Research Line Projects:

SRF-2-2-(2) Improvement of Navajo sheep by linebreeding and selection in the Navajo strain.

SRF-2-2-(5) Improvement of Navajo sheep by crossbreeding and selection for the production of wool suitable for both hand and commercial methods of manufacture.

SRF-2-2-(6) Improvement of Navajo sheep by crossbreeding and selection for range production of wool and lambs.

SRF-2-2-(7) Development of an efficient method of selecting animals used in the program of the Southwestern Range and Sheep Breeding Laboratory.

SRF-2-2-(8) Studies of the adaptability to southwestern ranges of crossbred strains of sheep having different proportions of Navajo and improved blood.

Research and Marketing Act Project:

Work authorized by the following Research and Marketing Act project of the Bureau of Animal Industry was conducted at this laboratory in addition to other locations including Dubois, Idaho, and Beltsville, Maryland.

RM-a-427-4 I Subtitle (BAI) Evaluation of wool from sheep, goats, and rabbits with respect to fabrication, felting, and insulation values. Line project title: Properties of blanket and rug wools of known genetic origin and history in relation to their use in fabrication, felting, and insulating values.

PUBLICATIONS

The following papers have been published since the establishment of the Southwestern Range and Sheep Breeding Laboratory:

1. The Navajo Sheep Industry and Needs for Its Improvement;
   J. M. Cooper, The Sheep Breeder, May 1939.

2. The Sheep Industry of Indians in the Southwest;
   J. M. Cooper and Dewey Dismuke, Indians At Work, August 1939.

3. Breeding for Adaptability to Local Conditions, with Special Reference to Sheep on the Navajo Indian Reservation;
   J. M. Cooper, American Society of Animal Production, 1939.

4. Improvement of the Navajo Sheep;
   Cecil T. Blunn, Journal of Heredity, March 1940.

5. Breeding for Quality Wool;
   James O. Grandstaff, The National Wool Grower, July 1940.

6. A Rapid Method for Projecting and Measuring Cross Sections of Wool Fibers;
   James O. Grandstaff and Walter L. Hodde, Circular No. 590, U. S. Department of Agriculture, December 1940.

7. Evaluating Fleece Characteristics of Navajo Sheep from a Breeding Standpoint;
   James O. Grandstaff, Rayon Textile Monthly, October-November 1941.

8. Wool Characteristics in Relation to Navajo Weaving;
   James O. Grandstaff, Technical Bulletin No. 790, U. S. Department of Agriculture, January 1942.

9. Characteristics and Production of Old-Type Navajo Sheep;
   Cecil T. Blunn, Journal of Heredity, May 1943.

10. The Influence of Seasonal Differences on the Growth of Navajo Lambs;
    Cecil T. Blunn, Journal of Animal Science, February 1944.

11. A Preliminary Report on the Post-natal Development of the Fiber Characteristics of the Fleeces of Navajo Sheep;
    James O. Grandstaff and Cecil T. Blunn, Journal of Animal Science, May 1944.

12. Comparison of the Yields of Side Samples from Weanling and Yearling Sheep;
    Cecil T. Blunn and James O. Grandstaff, Journal of Animal Science, May 1944.

13. Yearly Differences in Growth of Navajo and Crossbred Ewe Lambs;
    Cecil T. Blunn, Journal of Animal Science, August 1945.

14. Evaluating Fleece Quality of Navajo Sheep from Small Samples;
James O. Grandstaff and Cecil T. Blunn, Journal of Agricultural Research, September 1945.

15. Improvement of Wool for Navajo Hand Weaving;
James O. Grandstaff and Cecil T. Blunn, Indians At Work, March 1945.

16. Relation of Kemp and Other Medullated Fibers to Age in the Fleeces of Navajo and Crossbred Lambs;
James O. Grandstaff and Harold W. Wolf, Journal of Animal Science, May 1947.

17. Comparison of Corriedale x Navajo and Romney x Navajo Crosses;
James O. Grandstaff, Journal of Animal Science, November 1948.

18. Size of Lambs at Weaning as a Permanent Characteristic of Navajo Ewes;
George M. Sidwell and James O. Grandstaff, Journal of Animal Science, August 1949.

19. Adaptation of Livestock to New Environments; James O. Grandstaff, for publication in Proc. United Nations Scientific Conference on Conservation and Utilization of Resources, Lake Success, New York, 1949.

20. Fertility and Reproduction in Sheep in Relation to Breeding and Environment; James O. Grandstaff,
presented at International Symposium on High Altitude Biology held at Lima, Peru, South America, November 23-30, 1949.

SUMMARY OF PRECIPITATION

	Precipitation in Inches												
Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1864-1911	0.96	1.42	1.02	0.98	0.58	0.69	2.34	2.31	1.37	1.05	0.76	0.97	14.45
1938	0.52	0.79	1.95	0.43	0.61	1.67	0.78	1.84	0.85	0.10	0.67	0.24	10.47
1939	1.96	0.62	0.64	1.57	0.29	Tr.	0.85	1.23	1.31	0.30	0.10	1.22	10.09
1940	0.76	0.53	0.59	0.53	0.61	1.00	0.48	1.92	2.05	2.15	0.89	2.14	13.65
1941	0.89	1.12	1.80	1.46	2.10	0.76	0.71	1.75	4.05	2.40	0.73	0.70	18.47
1942	0.33	1.04	0.75	0.96	0.00	0.00	0.64	1.87	1.31	1.71	0.15	1.17	9.93
1943	1.48	0.24	1.61	0.46	0.28	0.41	2.30	1.94	0.30	1.65	Tr.	0.88	11.55
1944	0.64	0.71	1.07	0.21	0.87	0.14	1.10	1.91	0.99	1.49	0.93	1.42	11.48
1945	0.72	0.25	0.96	0.44	0.05	0.21	2.70	3.63	0.05	1.78	0.00	2.03	12.82
1946	0.49	0.07	0.25	0.72	Tr.	0.05	2.22	4.89	1.98	0.65	1.51	0.46	13.29
1947	0.48	0.10	0.12	Tr.	2.08	0.41	1.31	4.32	0.76	1.22	1.17	0.57	12.64
1948	0.24	1.19	1.15	0.13	0.58	1.09	2.38	2.23	1.14	0.69	0.17	1.64	12.63
1949	1.33	0.50	0.53	0.23	0.39	0.80	2.13	1.53	1.53	.82	0.00	0.95	10.74
1938-1949	0.82	0.60	0.95	0.59	0.65	0.55	1.47	2.42	1.36	1.25	0.53	1.12	12.31

The preceeding table summarizes the precipitation at Fort Wingate, New Mexico, for the 47-year period 1864-1911 and for individual years from 1938 to 1949 inclusive. In 1949 the total precipitation of 10.74 inches was about 14 percent below the average of the preceeding 11 years, and 25 percent below the 47-year average. In 1949 there was some precipitation in every month except November, but the proportion of total rainfall that was received during the first six months of the year was below normal.

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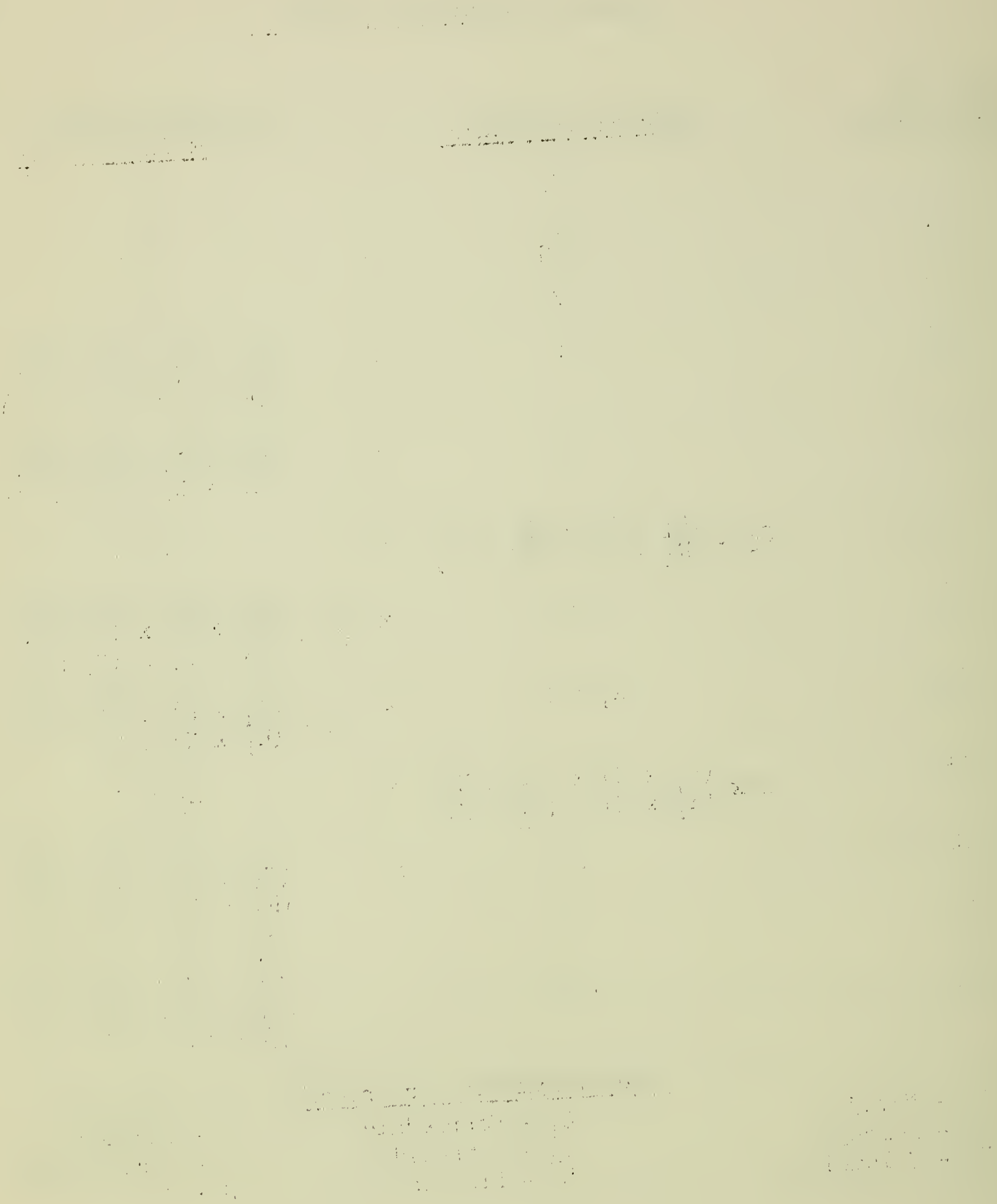
OUTLINE OF BREEDING PROGRAM

Number of Breeding Group	Breeding of Rams		Breeding of Ewes
1	N	x	N
2	R_1	x	N
3	K	x	N
6	L	x	(C_1 x N) x (R_1 x N) (R_1 x N) x (C_1 x N)
7	C_2	x	(C_1 x N) x (R_1 x N) (R_1 x N) x (C_1 x N)
8	C_2 x (C_1 x N) x (R_1 x N) (R_1 x N) x (C_1 x N)	x	K x N
9	K x N	x	C_2 x (C_1 x N) x (R_1 x N) (R_1 x N) x (C_1 x N)
10	R_1 x N	x	L x (C_1 x N) x (R_1 x N) (R_1 x N) x (C_1 x N)
11	L x (C_1 x N) x (R_1 x N) (R_1 x N) x (C_1 x N)	x	R_1 x N
12	T	x	(C_1 x N) x (R_1 x N) (R_1 x N) x (C_1 x N)
13	M		(C_1 x N) x (R_1 x N) (R_1 x N) x (C_1 x N)
14	D		(C_1 x N) x (R_1 x N) (R_1 x N) x (C_1 x N)

Code of Symbols for Breeds

N - Navajo
R_1 - Romney
K - Columbia
C_1 - Corriedale
C_2 - Cotswold
L - Lincoln
T - Targhee
M - Merino
D - Debouillet



SUMMARY OF BREEDING PENS

Breeding Group	Pen No.	Ram No.	Breeding of Rams	Breeding of Ewes	No. of Ewes
1	1	83E	N	N	34
1	2	19H	N	N	31
1	3	2I	N	N	34
1	4	58J	N	N	34
2	W18	71-45	R_1	N	31
2	W19	17-45	R_1	N	30
2	W20	19-46	R_1	N	29
2	W21	83-46	R_1	N	29
3	W13	4306K	K	N	26
3	W14	5228K	K	N	24
3	W15	5256K	K	N	25
3	W16	5355K	K	N	25
3	W17	5526K	K	N	25
6	W5	51-46	L	$(C_1 \times N) \times (R_1 \times N)$ $(R_1 \times N) \times (C_1 \times N)$	39
6	W6	108-46	L	$(C_1 \times N) \times (R_1 \times N)$ $(R_1 \times N) \times (C_1 \times N)$	37
6	W7	371	L	$(C_1 \times N) \times (R_1 \times N)$ $(R_1 \times N) \times (C_1 \times N)$	37
6	W8	468	L	$(C_1 \times N) \times (R_1 \times N)$ $(R_1 \times N) \times (C_1 \times N)$	39
7	W9	37-47	C_2	$(C_1 \times N) \times (R_1 \times N)$ $(R_1 \times N) \times (C_1 \times N)$	38
7	W10	361	C_2	$(C_1 \times N) \times (R_1 \times N)$ $(R_1 \times N) \times (C_1 \times N)$	36

SUMMARY OF BREEDING PENS (con't.)

Breeding Group	Pen No.	Ram No.	Breeding of Rams	Breeding of Ewes	No. of Ewes
7	W11	365	C_2	(C_1 x N) x (R_1 x N) (R_1 x N) x (C_1 x N)	38
7	W12	1381	C_2	(C_1 x N) x (R_1 x N) (R_1 x N) x (C_1 x N)	36
8	W27	44WJ	C_2 x (C_1 x N) x (R_1 x N) (R_1 x N) x (C_1 x N)	K x N	35
8	W28	666WJ	C_2 x (C_1 x N) x (R_1 x N) (R_1 x N) x (C_1 x N)	K x N	32
8	W29	131WJ	C_2 x (C_1 x N) x (R_1 x N) (R_1 x N) x (C_1 x N)	K x N	35
9	W22	334WJ	K x N	C_2 x (C_1 x N) x (R_1 x N) (R_1 x N) x (C_1 x N)	29
9	W23	56WJ	K x N	C_2 x (C_1 x N) x (R_1 x N) (R_1 x N) x (C_1 x N)	30
9	W24	399WJ	K x N	C_2 x (C_1 x N) x (R_1 x N) (R_1 x N) x (C_1 x N)	30
10	W25	473WJ	R x N	L x (C_1 x N) x (R_1 x N) (R_1 x N) x (C_1 x N)	32
10	W26	474WJ	R x N	L x (C_1 x N) x (R_1 x N) (R_1 x N) x (C_1 x N)	28
11	W30	107WJ	L x (C_1 x N) x (R_1 x N) (R_1 x N) x (C_1 x N)	R x N	23
11	W31	669WJ	L x (C_1 x N) x (R_1 x N) (R_1 x N) x (C_1 x N)	R x N	23
12	W33	3512T	T	(C_1 x N) x (R_1 x N) (R_1 x N) x (C_1 x N)	32
12	W34	3403T	T	(C_1 x N) x (R_1 x N) (R_1 x N) x (C_1 x N)	33
13	W32	3A-45	M	(C_1 x N) x (R_1 x N) (R_1 x N) x (C_1 x N)	31
14	W35	D1	D	(C_1 x N) x (R_1 x N) (R_1 x N) x (C_1 x N)	31

SUMMARY OF BREEDING PROGRAM

The breeding flock for the 1948-1949 season consisted of 1101 ewes. This figure is an increase of 133 ewes or 13.7 percent compared to the number of ewes bred in the 1947-1948 breeding season.

There were a total of 377 Navajo ewes, 133 of which were mated to Navajo rams, 119 to Romney rams, and 125 to Columbia rams. These matings make up groups 1, 2, and 3, respectively.

In groups 6 and 7, 300 crossbred ewes having an inheritance of 1/2 Navajo, 1/4 Corriedale, and 1/4 Romney were mated to rams of the Lincoln and Cotswold breeds, the Cotswold rams being used in group 7.

In group 8, 102 Columbia x Navajo ewes were mated to Cotswold cross rams. The ewes were produced in group 3, and the rams were produced in group 7. The 89 matings in group 9 were the reciprocal of those outlined for group 8, that is, Cotswold cross ewes were mated to Columbia x Navajo rams.

In group 10, 60 Lincoln cross ewes were mated to Romney x Navajo rams. The ewes originated in group 6, and the rams in group 2. The 46 matings of group 11 were the reciprocal of the matings in group 10.

At culling time, previous to breeding, 127 ewes with fleeces grading 1/2 blood or finer were selected from that portion of the flock previously mated to Lincoln and Cotswold rams. These ewes were mated to Targhee, Merino, and Debouillet rams, and designated as groups 12, 13, and 14, respectively.

The association of the various breeding groups with the research line projects is as follows: breeding group 1, SRF-2-2-(2); breeding groups 3 to 11 inclusive, SRF-2-2-(5); and breeding groups 12 to 14 inclusive, SRF-2-2-(6).

PROGENY TESTING OF CROSSBRED RAM LAMBS

In the 1948-1949 breeding season ram lambs were mated to 108 ewes, divided at random into five pens of about equal numbers. The ram lambs were selected from the progeny of four different breeding groups, and included one Romney x Navajo, two Columbia x Navajo, one Lincoln crossbred, and one Cotswold crossbred. The test pen ewes were predominately crossbreds produced from previous test pen matings or range breeding.

The progeny of each ram lamb was carefully evaluated for quality and uniformity as to body size, type, and fleece. Ram lambs which gave satisfactory breeding performance will be assigned to regular breeding pens as yearlings.

CHARACTERISTICS OF BREEDING RAMS

Breeding rams have been selected with major emphasis on fleece quality. Fleece characteristics considered are grade, staple length, uniformity, freedom from kemp and other medullated fibers, and yield of clean wool.

The accompanying table summarizes the fiber characteristics of the rams used in the 1948-1949 breeding season. Just prior to shearing the sheep, during the latter part of April, a fineness sample and a yield sample of wool were removed from the middle of the left side of each ram, for laboratory analysis. The fineness sample was used for determination of average fiber diameter, uniformity, staple length, and percentage of kemp and other medullated fibers. The rapid count method was used in obtaining the average fiber diameter and frequency of kemp and other medullated fibers. The yield samples were placed in moisture proof cans as collected, and later were scoured in the laboratory by the standard procedure. All fleeces were weighed at shearing time to the nearest 0.05 of a pound. Clean fleece weight was calculated by multiplying the grease fleece weight by the percentage yield of bone dry wool in the sample. The estimated clean fleece weight was then adjusted to a commercial basis with 12 percent moisture content by dividing by 0.88.

Fleece data on Navajo, Columbia, Targhee, and crossbred rams were obtained at yearling age. Data on Lincoln, Cotswold, and Romney rams were taken on fleeces sheared at two years of age as the rams were purchased after their yearling fleeces had been shorn. Fleece weights and staple length were adjusted to 365 days of wool growth.

No kemp fibers were present in samples from any of the rams used in the breeding program, but samples from the fleeces of three Cotswold rams, one Lincoln ram, and one Romney ram contained some medullated fibers, other than kemp. Fleece samples from all other rams were free of medullated fibers.

CHARACTERISTICS OF BREEDING RAMS

Pen No.	Breed	Ram No.	Age of ram at breeding (years)	Fleece weight as yearling Grease (lbs.)	Fleece weight as yearling : Clean* (lbs.)	Fineness at side Diameter (microns)	Fineness at side : Grade	Staple length (cms.)	Med. fibers (percent)
1	Navajo	83E	6	8.20	5.72	29.2	50's	18.5	0.0
2		19H	3	5.40	3.96	31.4	50's	17.3	.0
3		2I	2	7.63	5.23	33.0	48's	16.7	.0
4		58J	1	7.38	4.56	32.9	48's	18.5	.0
Averages				7.15	4.86	31.6	48's	17.8	.0
W18	Romney	71-45	3	11.80	8.57	35.0	46's	18.8	0.0
W19		17-45	3	12.30	9.40	39.0	36's	18.9	1.0
W20		19-46	2	10.42	6.76	35.7	44's	15.4	.0
W21		83-46	2	10.61	5.92	33.4	48's	12.3	.0
Averages				11.28	7.66	35.0	46's	16.4	.2
W13	Columbia	4306K	5	15.75	9.12	29.0	56's	11.9	0.0
W14		5228K	3	11.15	5.91	30.5	50's	11.8	.0
W15		5256K	3	12.15	7.98	27.4	56's	11.8	.0
W16		5355K	3	12.04	6.11	28.8	56's	10.3	.0
W17		5526K	3	11.00	6.85	32.6	48's	13.1	.0
Averages				12.42	7.20	29.6	50's	11.8	.0
W5	Lincoln	51-46	2	13.31	8.89	35.0	46's	23.9	8.3
W6		108-46	2	12.92	9.23	34.3	46's	20.0	.0
W7		371	1	16.70	11.91	33.0	48's	15.5	.0
W8		468	3	16.80	12.33	38.0	40's	23.4	.0
Averages				14.93	10.59	35.1	46's	20.7	2.1

CHARACTERISTICS OF BREEDING RAMS (con't.)

Pen No.	Breed	Ram No.	Age of ram at breeding (years)	Fleece weight as yearling Grease (lbs.)	Fleece weight as yearling Clean (lbs.)	Fineness at side Diameter (microns)	Fineness at side Grade	Staple length (cms.)	Med. fibers (percent)
W9	Cotswold	37-47	1	15.85	10.11	35.7	44's	13.3	5.4
W10		361	1	12.00	8.60	33.9	46's	27.6	.0
W11		365	1	19.05	14.24	37.2	40's	15.5	2.9
W12		1381	3	17.60	11.86	39.2	36's	32.5	10.2
Averages				16.13	11.22	36.5	44's	22.2	4.6
W22	Columbia F_1	334WJ	1	13.61	7.74	31.0	50's	12.5	0.0
W23		56WJ	1	11.12	5.18	30.2	50's	12.8	.0
W24		399WJ	1	12.15	5.92	27.9	56's	11.7	.0
Averages				12.29	6.28	29.7	50's	12.3	.0
W25	Lincoln Cross	473WJ	1	11.14	6.20	34.5	46's	13.1	0.0
W26		474WJ	1	10.07	5.32	32.7	48's	14.8	.0
Averages				10.60	5.76	33.6	46's	14.0	.0
W27	Cotswold Cross	44WJ	1	11.72	6.22	36.5	44's	15.7	0.0
W28		666WJ	1	10.38	7.20	34.3	46's	16.6	.0
W29		131WJ	1	9.17	5.82	31.0	50's	11.1	.0
Averages				10.42	6.08	33.9	46's	14.5	.0
W30	Romney F_1	107WJ	1	9.46	4.95	34.3	46's	13.5	0.0
W31		669WJ	1	9.73	4.22	31.8	48's	8.9	.0
Averages				9.60	4.59	33.1	48's	11.2	.0
W33	Targhee	3512T	2	13.55	6.86	22.1	64's	13.5	0.0
W34		3403T	2	11.46	6.58	20.1	70's	11.5	.0
Averages				12.51	6.72	21.1	64's	12.5	.0
W32	Merino	3A-45	3	10.60	7.07	25.0	60's	10.9	0.0
W34	Debouillet	D1	1	16.45		21.4	64's	13.0	0.0

CHARACTERISTICS OF BREEDING EWES

Data on various characteristics of the breeding ewes are summarized in the following table. Fleece weights and fiber characteristics were determined at yearling age, and body weights were taken at 18 months of age.

The ewes of groups 1, 2, and 3 were full-blood Navajo. Group 1 contained only two-year old ewes, and ewes six years of age or more. In general the young ewes had fleeces that were more improved than those of the aged ewes. In groups 2 and 3, the ewes were largely three, four, five, and six years of age. Average fleece weights of groups 2 and 3 were somewhat below the average for group 1, because there were many yearling ewes in the years, 1945, 1946, and 1947 that shed some wool before they were shorn. Except for this factor, the average fleece weights of Navajo ewes in groups 2 and 3 might have been equal to or even higher than the mean of group 1.

The ewes of groups 6 and 7 were of similar breeding having inheritance of 1/2 Navajo, 1/4 Corriedale, and 1/4 Romney. The two groups were practically identical with respect to body weight, fleece weight and fleece characteristics. The reason is that the ewes were divided between groups 6 and 7 by random selection.

The Columbia x Navajo ewes of group 8 had the highest fleece and body weights. The Cotswold cross ewes in group 9 ranked second highest in body weight and clean fleece weight, followed by the Lincoln cross ewes of group 9 and the Romney cross ewes of group 10.

The crossbred ewes of group 12, 13, and 14 having inheritance of 1/2 Navajo, 1/4 Corriedale, and 1/4 Romney were selected especially for fleeces of 1/2 blood fineness.

The ewe flock was culled during the latter part of October. The mouth and udder of each ewe was inspected for unsoundness. Lamb production records were available at time of culling so that ewes with a poor record of lamb production, or those producing undesirable lambs, were culled. Wool records were available on yearling ewes so that ewes with fleeces containing kemp were culled.

A total of 168 ewes were culled, this number being equivalent to 11.3 percent of the 1484 yearling and mature ewes on hand. A breakdown of the total percentage figure shows that 5.9 percent of the ewes were culled for age, 2.7 percent were culled for inferior fleeces, 1.3 percent for record of poor lamb production and less than one percent for unsound udder, and for excessive color on face and legs.

CHARACTERISTICS OF BREEDING EWES

Group no.	Pen no.	No. of ewes	Age of ewes at lambing (years)	Body weight at 18 mo. (lbs.)	Fleece weight as yearling Grease (lbs.)	Fleece weight as yearling Clean* (lbs.)	Fineness at side Diameter (microns)	Fineness at side Grade	Staple length (cms.)	Kemp (percent)	Other med. fibers (percent)
1	1	34	5.8	101.5	5.59	3.76	27.1	56's	9.5	0.1	0.8
	2	31	3.9	99.8	5.37	3.51	27.0	58's	10.5	.6	.9
	3	33	5.3	101.4	5.39	3.52	26.8	58's	9.9	.2	.6
	4	34	4.9	101.6	5.69	3.73	26.9	58's	10.3	.2	1.0
Total and Averages		132	5.0	101.1	5.51	3.64	27.0	58's	10.0	.3	.8
2	W18	31	4.3	97.9	4.09	2.85	28.0	56's	9.7	0.1	2.6
	W19	30	4.2	96.3	3.98	2.86	28.3	56's	10.2	.2	3.0
	W20	29	4.1	99.2	4.11	2.90	27.2	56's	9.4	.6	2.0
	W21	29	4.1	96.8	4.13	3.02	28.0	56's	9.8	.2	2.8
Total and Averages		119	4.2	97.6	4.08	2.91	27.9	56's	9.8	.3	2.6
3	W13	25	4.9	103.9	5.06	3.43	27.1	56's	10.7	0.3	1.6
	W14	24	4.6	94.6	4.68	3.20	27.3	56's	10.7	.5	2.3
	W15	25	4.3	101.9	4.95	3.36	27.6	56's	9.7	.1	1.1
	W16	25	4.4	100.2	5.02	3.59	28.8	56's	10.5	.2	2.2
	W17	25	4.5	98.8	4.71	3.27	27.8	56's	10.3	.4	3.4
Total and Averages		124	4.5	99.9	4.88	3.38	27.7	56's	10.4	.3	2.1
6	W5	39	4.3	106.8	6.05	3.48	28.5	56's	9.2	0.2	1.2
	W6	37	4.0	107.1	6.43	3.81	29.1	50's	9.9	.1	2.0
	W7	37	4.2	103.8	6.86	3.94	28.3	56's	10.1	.1	3.6
	W8	39	4.2	106.8	6.51	3.52	27.6	56's	9.3	.1	1.8
Total and Averages		152	4.2	106.1	6.46	3.68	28.4	56's	9.6	.1	2.2
7	W9	38	4.1	105.9	5.83	3.16	27.8	56's	9.3	0.1	1.6
	W10	36	4.0	106.1	6.46	3.89	28.0	56's	9.6	.4	2.2
	W11	38	4.1	108.2	6.22	3.60	27.9	56's	9.6	.1	1.6
	W12	36	4.0	105.9	6.53	3.70	28.2	56's	9.7	.1	3.0
Total and Averages		148	4.0	106.5	6.26	3.58	28.0	56's	9.5	.2	2.1

*Estimated clean weights of fleeces adjusted for 12 percent moisture content.

CHARACTERISTICS OF BREEDING EWES (con't.)

Group no.	Pen no.	No. of ewes	Age of ewes at lambing (years)	Body weight at 18 mo. (lbs.)	Fleece weight as yearling Grease (lbs.)	Fleece weight as yearling Clean (lbs.)	Fineness at side Diameter (microns)	Fineness at side Grade	Staple length (cms.)	Kemp (percent)	Other med. fibers (percent)
8	W27	35	2.5	120.6	8.17	4.75	30.1	50's	10.8	0.1	2.9
	W28	32	2.6	120.4	8.53	4.70	29.6	50's	10.8	.0	2.1
	W29	35	2.6	119.6	8.28	4.66	29.8	50's	10.7	.1	1.9
Total and Averages		102	2.6	120.2	8.23	4.70	29.9	50's	10.8	.1	2.3
9	W22	29	2.6	118.2	7.26	4.49	31.8	48's	13.7	0.1	3.4
	W23	30	2.5	117.3	7.56	4.62	32.4	48's	13.4	.0	2.2
	W24	30	2.6	116.6	7.12	4.40	32.0	48's	13.1	.1	3.0
Total and Averages		89	2.6	117.4	7.31	4.50	32.1	48's	13.4	.1	2.9
10	W25	32	2.0	115.7	7.34	3.80	28.8	56's	11.4	0.0	1.9
	W26	28	2.0	114.3	7.54	4.09	29.2	50's	11.2	.0	4.5
Total and Averages		60	2.0	115.0	7.43	3.93	29.0	56's	11.3	.0	3.1
11	W30	23	2.0	112.1	6.63	3.42	28.0	56's	8.6	0.0	1.6
	W31	23	2.0	110.8	7.73	3.77	28.6	56's	9.5	.0	2.6
Total and Averages		46	2.0	111.4	7.18	3.59	28.3	56's	9.0	.0	2.1
12	W33	33	4.9	109.7	6.08	3.19	25.5	60's	8.3	0.1	0.6
	W34	31	5.3	109.0	5.84	3.25	24.7	60's	7.9	.2	.3
Total and Averages		64	5.1	109.4	5.96	3.22	25.1	60's	8.1	.1	.4
13	W32	31	5.3	106.7	5.63	3.19	24.8	60's	8.2	0.2	0.4
14	W35	31	5.3	109.7	5.48	3.26	25.0	60's	8.3	0.0	0.7

LAMB PRODUCTION OF NAVAJO AND CROSSBRED EWES

The 1949 lamb production of Navajo and crossbred matings is summarized in the following table, by breeding groups and pens. The 12-year, 1937-1948, averages for both Navajo and crossbred matings are included for comparison with the 1949 figures.

In 1949 the lambs were born on the range, during the month of May, and were weaned August 31 and September 1. The weaning weights of the lambs were adjusted to a constant age of 120 days, and for differences due to type of birth and rearing, and for age of dam. The 12-year average weaning weights for Navajo and crossbred lambs includes 10 years in which the unadjusted individual weights of the lambs represent a growth period of about 140 days.

Among the crossbred groups, those numbered 6, 7, and 10 were below the 12-year average figure for percent of ewes lambing of ewes bred, while all other groups exceeded this average. The Navajo ewes of group 1 were slightly below the 12-year average for Navajo matings. However, when all Navajo ewes were considered, that is, including groups 2 and 3, the percent of ewes lambing of ewes bred was above the 12-year average. The low fertility of several of the rams in groups 6, 7, and 10 was the main factor responsible for the low percentage of pregnant ewes in these groups.

The percent of lambs born of ewes bred in group 1 was below the 12-year average for Navajo ewes. This was due partly to the fact that the ewes in group 1 were either past their most efficient age for lamb production, or they were two-year old ewes, resulting in fewer twin lambs born. Groups 3, 12, 13, and 14 were above the 12-year average with respect to percent of lambs born of ewes bred, all other groups were below this average. All ewes in groups 8 and 9 were either two or three years of age, and all ewes in groups 10 and 11 were two years of age. This fact must be considered when comparing percentages of lambs born of ewes bred as young ewes seldom equal mature ewes in the number of twin lambs born. Despite the fact that groups 8 and 9 contained only young ewes, the average weaning weights of their lambs exceeded the 12-year average by five and six pounds, respectively, and the 1949 average for all crossbred groups by two pounds or more.

The ewes of group 12, which were mated to Targhee rams, ranked first for pounds of lamb produced per ewe bred with 72.98 pounds, as compared to an average of 52.36 pounds for all crossbred groups. This was due primarily to the high percentage of lambs born and raised, rather than to an advantage in weaning weights of the lambs. The Navajo lambs of group 1 averaged 7.9 pounds below the average of all crossbred lambs, yet the pounds of lamb produced per ewe bred in group 1 slightly exceeded the average of all crossbred groups. This is attributed to the high fertility and excellent mothering ability of the Navajo ewes.

LAMB PRODUCTION OF NAVAJO AND CROSSBRED MATINGS

Group no.	Pen no.	Ram no.	No. of ewes bred	Percent of ewes lambing	Percent of lambs born of ewes bred	Percent of lambs weaned of ewes bred	Percent of lambs weaned of live lambs born	Average weaning weight in pounds	Pounds of lamb per ewe bred
1	1	83E	34	91.18	126.47	102.94	81.40	57.67	59.37
	2	19H	31	93.55	119.35	93.55	78.38	54.36	50.85
	3	2I	34	67.64	100.00	73.53	73.53	61.07	44.90
	4	58J	34	88.23	120.58	102.94	85.36	53.42	54.99
Total and Averages			133	84.96	116.54	93.23	80.00	56.38	52.57
2	W18	71-45	31	93.55	112.90	106.45	94.28	61.90	65.90
	W19	17-45	30	76.67	106.67	90.00	65.62	64.15	44.90
	W20	19-46	29	93.10	137.93	110.34	80.00	59.95	66.15
	W21	83-46	29	86.21	121.43	107.14	88.24	61.76	66.17
Total and Averages			119	87.39	119.49	98.31	82.27	61.73	60.68
3	W13	4306K	26	92.31	126.92	88.46	69.70	63.33	56.02
	W14	5228K	24	91.67	108.33	79.17	73.08	63.83	50.53
	W15	5256K	25	88.00	132.00	96.00	72.73	63.46	60.92
	W16	5355K	25	100.00	132.00	120.00	88.24	62.22	74.67
	W17	5526K	25	88.00	137.50	108.33	78.79	60.83	65.89
Total and Averages			125	92.00	128.23	98.39	76.58	63.03	62.02
6	W5	51-46	39	82.05	102.70	81.08	78.95	64.74	52.49
	W6	108-46	37	51.35	71.43	51.43	72.00	65.94	33.91
	W7	371-47	37	64.86	88.89	58.33	65.63	67.96	40.77
	W8	468-45	39	43.59	51.35	40.54	78.95	65.39	26.50
Total and Averages			152	60.52	78.62	57.93	73.68	65.92	38.19

LAMB PRODUCTION OF NAVAJO AND CROSSBRED MATINGS (con't.)

Group no.	Pen no.	Ram no.	No. of ewes bred	Percent of ewes lambing	Percent of lambs born of ewes bred	Percent of lambs weaned of ewes bred	Percent of lambs weaned of live lambs born	Average weaning weight in pounds	Pounds of lamb per ewe bred
7	W9	37-47	38	84.21	113.51	89.19	78.57	62.89	56.09
	W10	361-47	36	11.11	14.29	11.43	80.00	63.34	7.24
	W11	365-47	38	73.68	102.78	80.56	78.38	67.41	54.30
	W12	1381-45	36	61.11	74.29	57.14	76.92	65.29	37.31
Total and Averages			148	58.12	76.92	60.14	78.18	64.99	39.09
8	W27	44WJ	35	94.28	141.18	108.82	77.08	67.20	73.12
	W28	666WJ	32	81.25	112.90	80.65	71.43	65.42	52.75
	W29	131WJ	35	88.57	108.82	79.41	72.97	66.84	53.07
Total and Averages			102	88.24	121.21	89.90	74.17	66.59	59.86
9	W22	334WJ	29	82.76	103.57	78.57	75.86	69.94	54.95
	W23	56WJ	30	90.00	117.86	85.71	72.73	68.08	58.35
	W24	399WJ	30	93.33	131.03	110.34	84.21	65.49	72.26
Total and Averages			89	88.76	117.65	91.76	78.00	67.54	61.97
10	W25	473WJ	32	0.0	-	-	-	-	-
	W26	474WJ	28	82.14	100.00	61.54	61.54	65.73	40.44
Total and Averages			60	38.33	47.27	29.09	61.54	65.73	19.12
11	W30	107WJ	23	86.96	109.09	86.36	79.17	65.16	56.27
	W31	669WJ	23	86.96	95.45	77.27	80.95	67.48	52.14
Total and Averages			46	86.96	102.27	81.82	80.00	66.26	54.21

LAMB PRODUCTION OF NAVAJO AND CROSSBRED MATINGS (con't.)

Group no	Pen no.	Ram no.	No. of ewes bred	Percent of ewes lambing	Percent of lambs born of ewes bred	Percent of lambs weaned of ewes bred	Percent of lambs weaned of live lambs born	Average weaning weight in pounds	Pounds of lamb per ewe bred
12	W33	3512T	33	87.88	134.38	112.50	83.72	62.39	70.18
	W34	3403T	31	96.77	136.67	120.00	87.80	63.29	75.94
Total and Averages			64	92.19	135.48	116.67	85.71	62.85	72.98
13	W32	3A-45	32	90.62	128.12	106.25	82.93	61.20	65.02
14	W35	D1	31	87.10	138.71	100.00	72.09	61.46	61.46
ALL CROSSBRED MATINGS									
Total and Averages			968	76.86	104.80	81.45	77.72	64.29	52.36
1937-1948 TOTALS ANDS AVERAGES									
Navajo Matings			2828	88.14	128.09	102.42	89.62	57.48	58.93
Crossbred Matings			4546	82.63	122.87	91.27	84.28	61.57	56.17

GROWTH RATES OF NAVAJO AND CROSSBRED LAMBS

All Navajo and crossbred lambs weaned in 1949 were weighed at 28-day intervals from birth to approximately 120 days of age. The body weights of 888 ewe and ram lambs, taken at five different ages, are summarized by breeding group and sex in the following table.

Of the 888 lambs weighed periodically, 437 were ewe lambs, and 451 were ram lambs. There were 66 Navajo ram lambs and 56 Navajo ewe lambs. In the crossbred groups 2 to 14 there were 385 ram lambs and 379 ewe lambs.

Ram lambs were heavier than the ewe lambs at all ages, except that ewe lambs in group 11 averaged 0.24 pounds heavier than the ram lambs at eight weeks of age.

The average daily gain of Navajo ram lambs was 0.43 pound as compared to 0.38 pound for the ewe lambs. The crossbred groups of both sexes were heavier at all ages than Navajo lambs. The average daily gain of crossbred ram lambs, groups 2 to 14, ranged from 0.46 to 0.52 pound, and from 0.41 to 0.47 pound for ewe lambs.

The daily gain in pounds from birth to 120 days was calculated from the total adjusted weaning weight for each group minus the birth weight, and the sum divided by 120 days times the number of lambs in each group by sex.

BODY WEIGHTS AND AVERAGE DAILY GAIN OF NAVAJO AND CROSSBRED LAMBS

Group no.	No. of lambs	Sex	Weight in pounds at five ages					Average daily gain in pounds. Birth to 120 da.
			Birth	4 Weeks	8 Weeks	12 Weeks	16 Weeks	
1	66	Rams	7.54	20.89	33.45	46.42	55.18	0.43
2	60		9.03	25.85	40.78	56.35	65.28	.47
3	60		8.68	23.43	39.05	54.80	64.57	.49
6	43		9.89	26.33	41.98	58.09	66.93	.49
7	39		9.96	26.00	41.21	57.54	66.77	.49
8	41		8.72	24.98	40.05	56.59	67.17	.52
9	41		8.57	26.51	42.44	58.07	68.32	.51
10	10		8.56	29.90	44.90	61.60	69.90	.50
11	17		9.04	24.88	38.76	53.35	64.12	.51
12	41		8.93	23.51	37.12	51.68	60.76	.47
13	17		9.09	26.00	40.35	55.41	64.41	.46
14	16		8.43	20.25	33.56	47.88	57.94	.46
1	58	Ewes	6.86	19.19	30.09	41.79	48.57	0.38
2	56		8.19	21.68	34.82	47.57	54.38	.41
3	62		8.29	21.82	34.87	48.00	55.79	.42
6	41		9.17	25.17	39.68	53.88	61.95	.45
7	47		9.12	24.96	37.66	50.98	58.09	.44
8	48		8.38	23.58	37.33	52.02	59.88	.45
9	37		8.29	26.32	41.05	55.54	63.86	.47
10	6		7.63	24.83	39.83	52.50	60.33	.44
11	19		8.62	24.58	39.00	53.16	59.84	.45
12	31		8.35	22.68	36.00	48.19	55.81	.43
13	17		8.05	21.41	34.35	46.65	54.18	.41
14	15		8.07	21.73	35.07	48.60	56.20	.43

FIBER AND FLEECE CHARACTERISTICS OF WEANLING LAMBS

Wool samples were collected from the middle of the left side and thigh of all lambs on August 31 and September 1. These samples were analyzed in the laboratory for the determination of fineness, staple length, and percentages of kemp and other medullated fibers. Fineness and frequency of kemp and other medullated fibers were determined by the rapid count method. Staple length measurements were made on an actual 84 days of wool growth. This was accomplished by shearing an area on the middle of the left side of each lamb on June 8 and 9, and resampling the same area for staple length on August 31 and September 1.

The following table summarizes, by pens and groups, the fiber characteristics of the weanling lambs. Data on the thigh samples, omitted from the table, shows that wool from the thigh region of the fleece was generally coarser and contained higher percentages of kemp and other medullated fibers than the wool of the side region.

At culling time all lambs were given a numerical score for outercoat, face covering, body type, and condition. In scoring for outercoat, numerical values were recorded for each weanling lamb which represents the relative amount of outercoat or coarse tipped fibers in the entire fleece. A description of the different outercoat scores representing numerical values of 1 to 5 are as follows:

1. Fleeces with no distinct outercoat.
2. Outercoat or extreme coarseness evident only in the thigh region.
3. Outercoat or hairiness extending over the thigh, rump, and lower sides.
4. Outercoat or hairiness in small quantities throughout the entire fleece.
5. Outercoat fibers strongly evident throughout the entire fleece.

The scoring range is increased to 15 values by using plus and minus values with each numerical score.

The average fiber diameter for each of the different groups of weanling lambs was slightly greater than the 1948 values. This may have been due to the effect of selection on sires and dams in some groups. Lambs from groups 6 and 7 should be slightly coarser in fleece than in previous years as the ewes with finest wool were selected from these two groups and assigned to groups 12, 13, and 14.

Lambs sired by Cotswold rams had the coarsest fleeces. Lambs sired by Cotswold and Lincoln rams had the longest staple wool and the largest outercoat scores. Average staple length of each of the different groups of crossbred lambs was slightly less in 1949 than for corresponding groups in 1948. The reason for this difference is not apparent at this time.

The outercoat scores of all groups were lower in 1949 than in 1948. However, the relative percentages of kemp and other medullated fibers appear to be about the same as in 1948.

It is interesting to note that the quality of the Navajo lambs was noticeably higher than in 1948. The lambs had coarser, longer wool with less kemp and other medullated fibers than in 1948. Also, they had a lower outercoat score than the lambs born in 1948. These improvements in fleece quality represent gains resulting from the effect of selection practices.

FIBER CHARACTERISTICS OF NAVAJO AND CROSSBRED LAMBS AT WEANING AGE

Group no.	Pen no.	No. of lambs	Fineness at side Diameter (microns)	: Grade	Staple length (cms.)	Kemp (percent)	Other med. fibers (percent)	Outer-coat (score)
1	1	35	28.8	56's	4.2	0.1	1.3	3.25
	2	29	29.6	50's	4.0	.2	1.9	3.20
	3	25	29.2	50's	3.9	.3	3.7	2.98
	4	35	29.2	50's	4.1	.3	1.9	3.22
Total and Averages		124	29.2	50's	4.1	.2	2.1	3.18
2	W18	33	29.2	50's	3.9	0.4	1.5	2.83
	W19	22	28.8	56's	4.2	.6	1.9	3.00
	W20	32	29.7	50's	4.1	.1	1.4	2.83
	W21	30	28.8	56's	3.8	.3	2.4	2.87
Total and Averages		117	29.2	50's	4.0	.3	1.8	2.87
3	W13	23	26.4	58's	3.7	0.2	4.0	2.92
	W14	19	27.6	56's	4.0	.1	2.1	2.82
	W15	24	27.1	56's	3.3	.8	4.7	2.83
	W16	30	28.3	56's	3.6	.2	3.4	2.96
	W17	26	28.2	56's	3.8	.1	3.0	2.74
Total and Averages		122	27.6	56's	3.7	.3	3.5	2.86
6	W5	30	28.8	56's	5.0	0.0	1.9	3.22
	W6	18	29.6	50's	5.0	.1	6.3	3.08
	W7	21	28.4	56's	4.9	.1	3.4	3.36
	W8	15	28.5	56's	4.3	.0	5.1	3.25
Total and Averages		84	28.8	56's	4.9	.0	3.8	3.23
7	W9	33	29.2	50's	4.7	0.3	4.7	3.22
	W10	4	29.8	50's	5.6	.0	.0	3.00
	W11	29	30.1	50's	5.0	.0	4.4	3.17
	W12	20	29.2	50's	5.0	.2	6.0	3.28
Total and Averages		86	29.5	50's	4.9	.2	4.7	3.21

FIBER CHARACTERISTICS OF NAVAJO AND CROSSBRED LAMBS AT WEANING AGE (con't.)

Group no.	Pen no.	No. of lambs	Fineness at side Diameter (microns)	Fineness at side Grade	Staple length (cms.)	Kemp (percent)	Other med. fibers (percent)	Outer-coat (score)
8	W27	37	29.2	50's	4.3	0.1	6.1	3.09
	W28	25	30.0	50's	4.8	.0	3.8	3.13
	W29	27	28.3	56's	4.1	.1	4.4	2.90
Total and Averages		89	29.2	50's	4.4	.1	4.9	3.04
9	W22	22	28.3	56's	4.8	0.0	2.7	2.85
	W23	24	29.4	50's	4.0	.1	2.1	2.76
	W24	32	27.6	56's	4.2	.1	2.6	2.85
Total and Averages		78	28.4	56's	4.3	.1	2.5	2.82
10	W25	0	0.0	0	0.0	0.0	0.0	0.00
	W26	16	27.9	56's	4.3	.0	2.0	2.72
Total and Averages		16	27.9	56's	4.3	.0	2.0	2.72
11	W30	19	28.1	56's	3.6	0.2	1.5	2.54
	W31	17	29.3	50's	4.1	.0	.8	2.61
Total and Averages		36	28.7	56's	3.8	.1	1.2	2.57
12	W33	36	24.8	60's	3.5	0.1	0.5	2.40
	W34	36	24.3	60's	3.4	.1	.5	2.19
Total and Averages		72	24.6	60's	3.5	.1	.5	2.20
13	W32	34	25.0	60's	3.3	0.1	0.6	2.18
14	W35	31	22.5	64's	3.2	0.1	0.5	2.48

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FACE AND BODY SCORES FOR WEANLING LAMBS

At weaning time, when the lambs were approximately 120 days of age, all lambs were scored for face covering, body type, and condition. These scores are summarized by sex, groups, and pens in the following table.

The Navajo lambs of both sexes had less face covering than crossbred lambs. The standard deviation for this trait showed the Navajo lambs to be slightly more variable in this trait than the crossbred lambs. However, the scores indicated that all lambs were either open-faced, or that wool blindness did not exist to any great extent. Very little difference was apparent between the crossbred groups with respect to degree of face covering. The Columbia cross lambs from group 3 had the least face covering of all crossbred lambs.

All crossbred groups were superior to the Navajo lambs in body type and condition. The lambs from group 9 had the best type scores. Ewe lambs were scored less desirable than ram lambs with respect to type and condition. Larger standard deviations indicated the ewe lambs were slightly more vairable with respect to these characteristics. All of these same differences were observed in the 1948 lambs.

FACE AND BODY SCORES FOR NAVAJO AND CROSSBRED LAMBS AT WEANING AGE

		RAM LAMBS				EWE LAMBS			
Group no.	Pen no.	No. of lambs	Face covering (score)	Type (score)	Condition (score)	No. of lambs	Face covering (score)	Type (score)	Condition (score)
1	1	20	2.70	3.04	2.97	15	2.72	3.19	2.86
	2	13	2.89	3.07	3.01	16	2.86	3.15	2.99
	3	18	2.77	2.97	2.90	7	3.15	3.07	2.76
	4	15	2.20	3.36	3.13	20	2.26	3.36	2.97
Total and Averages		66	2.64	3.09	3.00	58	2.65	3.22	2.92
2	W18	17	3.05	2.24	2.35	16	2.89	2.73	2.47
	W19	11	2.96	2.47	2.55	11	2.88	2.39	2.47
	W20	16	3.29	2.44	2.61	16	3.16	2.50	2.39
	W21	16	2.82	2.55	2.57	14	3.03	2.67	2.52
Total and Averages		60	3.04	2.42	2.51	57	3.00	2.58	2.46
3	W13	11	2.90	2.68	2.42	12	2.92	2.53	2.72
	W14	6	3.14	2.06	2.34	13	3.15	2.45	2.44
	W15	13	2.65	2.61	2.55	11	2.49	2.83	2.70
	W16	17	2.69	2.56	2.61	13	2.87	2.74	2.66
	W17	13	2.98	2.59	2.50	13	2.85	2.76	2.62
Total and Averages		60	2.83	2.55	2.51	62	2.87	2.66	2.62
6	W5	15	3.00	2.42	2.47	15	2.75	2.39	2.31
	W6	9	2.97	2.26	2.52	9	2.78	2.59	2.61
	W7	11	3.14	2.56	2.65	10	2.70	2.43	2.45
	W8	8	2.84	2.40	2.63	7	2.95	2.67	2.51
Total and Averages		43	3.00	2.42	2.55	41	2.78	2.49	2.44
7	W9	18	3.02	2.38	2.46	15	3.07	2.69	2.63
	W10	1	2.50	2.84	3.00	3	3.00	2.00	2.33
	W11	12	3.26	2.33	2.35	18	3.18	2.80	2.74
	W12	8	3.42	2.48	2.67	12	3.32	2.54	2.63
Total and Averages		39	3.16	2.40	2.48	48	3.17	2.65	2.65
8	W27	19	3.34	2.61	2.50	18	3.08	2.60	2.33
	W28	12	3.18	2.54	2.65	13	3.22	2.60	2.49
	W29	10	2.98	2.39	2.49	17	3.01	2.64	2.52
Total and Averages		41	3.20	2.54	2.54	48	3.09	2.61	2.44

FACE AND BODY SCORES FOR NAVAJO AND CROSSBRED LAMBS AT WEANING AGE
(con't.)

		RAM LAMBS				EWE LAMBS			
Group no.	Pen no.	No. of lambs	Face covering (score)	Type (score)	Condition (score)	No. of lambs	Face covering (score)	Type (score)	Condition (score)
9	W22	9	3.57	2.46	2.71	13	3.18	2.24	2.20
	W23	14	2.94	2.32	2.51	10	3.04	2.53	2.34
	W24	18	2.93	2.41	2.48	14	2.88	2.61	2.48
Total and Averages		41	3.07	2.39	2.54	37	3.02	2.45	2.34
10	W25	0	0	0	0	0	0	0	0
	W26	10	2.98	2.10	2.23	6	2.89	2.50	2.42
Total and Averages		10	2.98	2.10	2.23	6	2.89	2.50	2.42
11	W30	11	3.14	2.67	2.55	8	2.92	2.56	2.50
	W31	6	3.31	2.08	2.36	11	3.03	2.24	2.26
Total and Averages		17	3.20	2.46	2.48	19	2.98	2.37	2.36
12	W33	18	3.22	2.64	2.61	18	3.21	2.55	2.44
	W34	23	3.10	2.41	2.33	13	3.02	2.51	2.31
Total and Averages		41	3.15	2.51	2.45	31	3.13	2.53	2.39
13	W32	17	2.99	2.30	2.28	17	2.97	2.59	2.40
14	W35	16	3.07	2.79	2.80	15	2.93	2.61	2.36

SELECTION PRACTICED ON NAVAJO AND CROSSBRED LAMBS

Beginning the week of October 17, the lambs were sorted by sex into their respective breeding pens to facilitate the work of selection. The lambs of each pen were considered individually for all traits evaluated at weaning time. Also, each pen of lambs were scored as a group for size, type, condition, face covering, and fleece quality, and for uniformity in these characteristics. Defects and outstanding characteristics were noted. The degree of selection practiced on each pen of lambs depended upon the individual merit of the lambs, and the quality and uniformity of the pen of lambs as a group. A high proportion of the Navajo ewe lambs was saved because of the critical need for replacement ewes.

From a total of 570 ram lambs weaned, 149 were saved. Of this 149 lambs, 10 were Navajo lambs from group 1, 127 were crossbred lambs from groups 2 to 14, four were from test pen matings, and eight were lambs born in June as a result of range breeding. A total of 391 ewe lambs were saved from the 591 lambs that were weaned. Ewe lambs saved included 275 from groups 2 to 14, 46 from group 1, 30 from test pen matings, and 40 from ewes lambing as a result of range breeding.

The percentage of lambs saved in each group, the selection differential for all traits considered at weaning age, the relative emphasis placed on each trait at culling time, and the expected genetic gains are given in the following table.

The selection differential for each trait is the difference between the selected lambs and the unselected group from which they were chosen. The relative emphasis placed on each trait was calculated by dividing the selection differential by the standard deviation for that trait. The emphasis placed on each trait at culling time varied somewhat for each group, but in general the greatest emphasis for both sexes was placed on body type followed by weaning weight.

Selection against kemp and coarse outercoat fibers automatically resulted in some selective pressure against staple length and coarse fiber diameter, since both staple length and fiber diameter are influenced by these objectionable fibers when present in the fleece. However, the incidence of both kemp and other medullated fibers has been reduced to a very low level as a result of intensive selection over a period of 13 years.

Percentages of kemp and other medullated fibers based on a total fiber count shows that in all ram lambs weaned only 0.15 percent of kemp fibers were found, and only 2.56 percent of other medullated fibers were found. In the ewe lambs 0.18 percent of kemp fibers were found, and 2.67 percent of other medullated fibers were found. In the saved lambs the incidence of kemp was reduced to 0.01 percent for the ram lambs, and to 0.05 percent for ewe lambs.

The percent of other medullated fibers for the saved lambs was 1.29 percent for the ram lambs, and 1.50 percent for the ewe lambs.

Selection differentials were computed for kemp and other medullated fibers, but are not included in the following table due to lack of space. However, all selection differentials for all groups showed a positive selection against kemp if any of these objectionable fibers were present in the fleece. No kemp fibers were found in any of the ewe lambs in groups 6, 10, and 12, or in the ram lambs in groups 10 and 11.

The expected genetic gain from selections made was obtained by multiplying the selection differential by the heritability estimate for that trait. Since no heritability values have been computed at this station for these traits, those obtained for range Rambouillet lambs at Dubois, Idaho, have been used. To the extent that these heritability estimates are representative of the lambs at this station, the estimates of genetic gain represent how much the selected groups are superior in actual breeding value to the unselected groups from which they were chosen.

SELECTION DIFFERENTIALS, RELATIVE EMPHASIS, AND EXPECTED GENETIC GAIN FOR 1949 WEANLING LAMBS

Group no.	Sex		Weaning weight (lbs.)	Staple length (cms.)	Fiber diameter (microns)	Face covering (score)	Body type (score)	Condition (score)	Color (score)	Outer-coat (score)	Percent saved
1	Rams	Advantage of selected lambs	4.86	.33	.58	.28	.31	.11	-.03	.52	15.15
		Relative emphasis	.67	.41	.31	.54	.72	.26	-.08	.71	
		Expected genetic gain	1.46	.13		.15	.04	.004			
	Ewes	Advantage of selected lambs	.45	-.06	-.40	.07	.04	.03	.01	.08	79.31
		Relative emphasis	.07	-.06	-.16	.04	.02	.01	.006	.05	
		Expected genetic gain	.13	-.02		.04	.00	.001			
2	Rams	Advantage of selected lambs	4.41	.15	.73	.11	.36	.36	.50	.29	30.00
		Relative emphasis	.49	.25	.36	.25	.76	.84	.54	.58	
		Expected genetic gain	1.32	.06		.06	.05	.01			
	Ewes	Advantage of selected lambs	1.31	-.03	.00	.03	.12	.07	.21	.07	66.67
		Relative emphasis	.18	-.05	.00	.09	.27	.20	.30	.16	
		Expected genetic gain	.39	-.01		.02	.02	.003			
3	Rams	Advantage of selected lambs	4.93	.07	.00	-.03	.34	.29	.08	.34	36.67
		Relative emphasis	.65	.27	.00	-.04	.63	.63	.13	.60	
		Expected genetic gain	1.48	.03		-.01	.04	.01			
	Ewes	Advantage of selected lambs	1.47	-.05	-.05	-.03	.08	.09	.08	.18	67.74
		Relative emphasis	.19	-.07	-.03	-.09	.14	.21	.14	.43	
		Expected genetic gain	.53	-.02		-.00	.01	.004			

SELECTION DIFFERENTIALS, RELATIVE EMPHASIS, AND EXPECTED GENETIC GAIN FOR 1949 WEANLING LAMBS (con't.)

Group no.	Sex		Weaning weight (lbs.)	Staple length (cms.)	Fiber diameter (microns)	Face covering (score)	Body type (score)	Condition (score)	Color (score)	Outer-coat (score)	Percent saved
6	Rams	Advantage of selected lambs	6.41	-.15	-.45	.20	.20	.05	.28	.26	30.23
		Relative emphasis	.90	-.16	-.21	.62	.53	.12	.44	.53	
		Expected genetic gain	1.92	-.06		.11	.03	.002			
	Ewes	Advantage of selected lambs	1.80	-.06	-.17	.00	.11	.05	.03	.09	75.61
		Relative emphasis	.24	-.04	-.08	.00	.26	.13	.03	.17	
		Expected genetic gain	.54	-.02		.00	.01	.002			
7	Rams	Advantage of selected lambs	3.20	-.07	-.06	.16	.29	.01	.33	.06	34.21
		Relative emphasis	.38	-.09	-.03	.36	.55	.02	.34	.15	
		Expected genetic gain	.96	-.03		.09	.04	.00			
	Ewes	Advantage of selected lambs	2.70	.00	-.02	.00	.17	.12	.14	.12	70.21
		Relative emphasis	.31	.00	-.01	.00	.33	.23	.16	.20	
		Expected genetic gain	.81	.00		.00	.02	.005			
8	Rams	Advantage of selected lambs	4.76	.70	.18	.06	.31	.20	.18	.46	31.71
		Relative emphasis	.70	.89	.16	.12	.70	.48	.17	.69	
		Expected genetic gain	1.43	.30		.03	.04	.008			
	Ewes	Advantage of selected lambs	1.47	-.03	.00	.07	.15	.11	.12	.20	68.75
		Relative emphasis	.18	-.03	.00	.20	.40	.28	.12	.28	
		Expected genetic gain	.44	-.01		.04	.02	.004			

SELECTION DIFFERENTIALS, RELATIVE EMPHASIS, AND EXPECTED GENETIC GAIN FOR 1949 WEANLING LAMBS (con't.)

Group no.	Sex		Weaning weight (lbs.)	Staple length (cms.)	Fiber diameter (microns)	Face covering (score)	Body type (score)	Condition (score)	Color (score)	Outer-coat (score)	Percent saved
9	Rams	Advantage of selected lambs	2.79	.32	-.25	.00	.10	.12	.04	.15	36.58
		Relative emphasis	.34	.33	-.09	.00	.20	.24	.05	.24	
		Expected genetic gain	.84	.13		.00	.01	.005			
	Ewes	Advantage of selected lambs	.39	-.10	.16	.02	.06	.10	.20	.11	75.68
		Relative emphasis	.06	-.11	.09	.03	.14	.23	.19	.20	
		Expected genetic gain	.12	-.04		.01	.01	.004			
10	Rams	Advantage of selected lambs	4.03	.27	-.04	.18	.26	.02	.00	-.14	40.00
		Relative emphasis	.71	.44	-.02	.67	.74	.09	.00	-.28	
		Expected genetic gain	1.21	.10		.10	.03	.00			
	Ewes	Advantage of selected lambs	2.14	.11	.31	.02	-.09	-.13	.00	-.19	83.33
		Relative emphasis	.33	.20	.17	.07	-.21	-.32	.00	-.30	
		Expected genetic gain	.64	.04		.01	-.01	-.005			
11	Rams	Advantage of selected lambs	2.21	.38	2.00	.14	.43	.35	.25	.22	29.41
		Relative emphasis	.22	.57	.71	.34	.63	.78	.32	.52	
		Expected genetic gain	.66	.15		.07	.06	.01			
	Ewes	Advantage of selected lambs	2.54	.11	.18	.07	.17	.19	.17	.07	78.95
		Relative emphasis	.29	.18	.11	.23	.38	.38	.28	.15	
		Expected genetic gain	.76	.04		.04	.02	.008			

SELECTION DIFFERENTIALS, RELATIVE EMPHASIS, AND EXPECTED GENETIC GAIN FOR 1947 WEANLING LAMBS (con't.)

Group no.	Sex		Weaning weight (lbs.)	Staple length (cms.)	Fiber diameter (microns)	Face covering (score)	Body type (score)	Condition (score)	Color (score)	Outer-coat (score)	Percent saved
12	Rams	Advantage of selected lambs	5.28	.18	-.28	.06	.47	.33	.25	.27	34.14
		Relative emphasis	.80	.25	-.22	.21	.82	.72	.30	.54	
		Expected genetic gain	1.58	.07		.03	.06	.01			
	Ewes	Advantage of selected lambs	2.20	.05	.17	.04	.13	.07	.06	.01	80.64
		Relative emphasis	.26	.11	.07	.06	.24	.16	.12	.03	
		Expected genetic gain	.66	.02		.02	.02	.003			
13	Rams	Advantage of selected lambs	4.49	.36	.94	.03	.26	.21	-.31	.18	29.41
		Relative emphasis	.64	.65	.48	.07	.76	.66	-.52	.42	
		Expected genetic gain	1.34	.14		.01	.03	.008			
	Ewes	Advantage of selected lambs	.10	.02	-.10	.05	.00	-.03	.02	.06	82.35
		Relative emphasis	.01	.04	-.06	.12	.00	-.07	.04	.21	
		Expected genetic gain	.03	.008		.02	.00	-.001			
14	Rams	Advantage of selected lambs	5.20	.03	.73	.00	.36	.00	.00	.24	31.25
		Relative emphasis	.81	.08	.58	.00	.75	.00	.00	.70	
		Expected genetic gain	1.56	.01		.00	.04	.00			
	Ewes	Advantage of selected lambs	.61	-.07	.34	.04	.02	.03	-.08	.24	80.00
		Relative emphasis	.06	-.16	.21	.13	.05	.09	-.10	.28	
		Expected genetic gain	.18	-.03		.02	.003	.001			

SELECTION DIFFERENTIALS, RELATIVE EMPHASIS, AND EXPECTED GENETIC GAIN FOR 1949 WEANLING LAMBS (con't.)

Group no.	Sex		Weaning weight (lbs.)	Staple length (cms.)	Fiber diameter (microns)	Face covering (score)	Body type (score)	Condition (score)	Color (score)	Outer-coat (score)	Percent saved
All crossbred groups	Rams	Advantage of selected lambs	4.49	.13	.11*	.07	.31	.20	.20	.25	33.07
		Relative emphasis	.57	.15	.05	.17	.60	.44	.22	.40	
		Expected genetic gain	1.35	.05		.04	.04	.008			
	Ewes	Advantage of selected lambs	1.59	-.03	.01*	.02	.11	.09	.11	.13	72.63
		Relative emphasis	.21	-.03	.00	.05	.23	.20	.21		
		Expected genetic gain	.48	-.01		.01	.01	.004			

*Does not include groups 12, 13, and 14.

BODY WEIGHTS AND SCORES OF YEARLING NAVAJO AND CROSSBRED EWES

Prior to shearing the sheep in April, all yearling ewes were scored for face covering, color on the face and legs, and amount of outercoat fibers in their fleeces. Body weights, type, and condition scores were taken in June. The weights and scores are summarized in the following table along with the 1948 averages for all groups.

Scoring the fleeces of yearling ewes and rams for outercoat was initiated in 1949, and represents an effort to obtain a single numerical value for hairiness of fleece, as has been done with other qualitative characteristics. The numerical values and a description of the amount of outercoat covering for each value is found on page 22 of this report.

The different crossbred groups of yearling ewes were remarkably uniform in average body weights. A difference of only 3.5 pounds existed between the heaviest and lightest groups, numbered 3 and 2, respectively. The Navajo ewes were 7.5 pounds below the average of all crossbred groups. Also, the Navajo ewes were less desirable than the crossbred ewes with respect to type, condition, color, and outercoat scores. There was no appreciable difference between the groups of crossbred ewes in type, condition, and face covering scores. Group 3 ewes had slightly superior scores for these traits. The average weight of yearling ewes in 1949 exceeded the 1948 figure by 9.8 pounds.

BODY WEIGHTS AND SCORES OF YEARLING NAVAJO AND CROSSBRED EWES

Group no.	Pen no.	No. of ewes	Body weight (pounds)	Face covering (score)	Type (score)	Condition (score)	Color (score)	Outer-coat (score)
1	1	19	79.0	2.43	2.75	2.51	1.95	2.77
	2	12	77.3	2.37	2.89	2.39	1.64	3.90
	3	16	83.3	2.13	2.59	2.47	1.63	3.03
	4	8	76.3	2.29	2.79	2.59	1.50	2.79
Total and Averages 1949		55	77.9	2.31	2.74	2.49	1.72	3.08
Total and Averages 1948		75	86.8	2.58	2.97	2.68	1.32	
2	W12	12	87.3	2.32	2.20	2.32	1.42	2.39
	W13	8	80.5	2.29	2.23	2.42	1.00	2.10
	W14	13	80.6	2.30	2.33	2.11	1.23	2.23
	W15	14	85.7	2.54	2.17	2.06	1.79	2.32
Total and Averages		47	83.7	2.38	2.23	2.21	1.41	2.28
3	W7	15	86.5	2.69	2.11	2.50	1.08	2.40
	W8	6	85.5	2.56	2.25	2.17	1.17	2.39
	W9	12	91.5	2.29	2.10	2.29	1.00	1.83
	W10	13	86.7	2.16	2.13	1.93	1.00	2.45
	W11	14	85.6	2.43	2.04	2.09	1.07	2.23
Total and Averages		60	87.2	2.41	2.11	2.12	1.05	2.26
6	W1	25	83.7	2.28	2.34	2.33	1.44	3.05
	W2	30	82.3	2.21	2.33	2.39	1.40	3.10
	W3	15	89.0	1.95	2.13	2.37	1.92	2.98
	W4	23	86.2	2.53	2.18	2.28	1.65	2.89
Total and Averages		93	84.8	2.27	2.27	2.34	1.55	3.02
7	W5	18	87.1	2.26	2.30	2.37	2.06	3.38
	W6	15	83.7	2.58	2.28	2.49	1.13	3.47
Total and Averages		33	85.5	2.41	2.29	2.43	1.64	3.42
8	W16	2	95.6	2.25	1.92	2.33	1.50	2.92
	W17	14	85.6	2.32	2.23	2.25	1.77	2.71
Total and Averages		16	86.8	2.31	2.19	2.26	1.62	2.73
9	W18	4	88.8	2.13	2.29	2.38	1.50	2.25
	W19	7	84.0	2.36	2.22	2.33	1.14	2.91
Total and Averages		11	85.7	2.27	2.24	2.35	1.27	2.67
All Crossbred Groups:								
Total and Averages (1949)		260	85.4	2.34	2.22	2.27	1.38	2.74
Total and Averages (1948)		285	95.2	2.85	2.28	2.00	1.37	

BODY WEIGHTS AND SCORES OF YEARLING NAVAJO AND CROSSBRED RAMS

The following table summarizes the body weights and scores by groups for 14 yearling Navajo rams and 98 crossbred rams. In April, just prior to being shorn, all rams were scored for face covering, color on the face and legs, and outercoat. Body weights, type, and condition scores were taken in June. The 1948 averages for all rams are included in this table for comparison with the 1949 data.

The rams of group 3, representing the Columbia x Navajo cross, with an average body weight of 130.4 pounds, were heavier than the rams of any other group, and also were superior to other groups in condition and color scores. Group 9 rams scored best in type, and were exceeded in body weight only by the Columbia x Navajo rams. The Navajo rams of group 1 and the crossbred rams of group 9 had less face covering than other groups, however, all groups were definitely open faced. The Romney x Navajo cross rams of group 2 were given the best outercoat scores, and the Lincoln and Cotswold crosses, groups 6 and 7, had the least desirable outercoat scores. The high outercoat scores for the long-wooled crossbreds reflect a "tippy" fleece rather than one having a distinct outercoat, as found in the fleeces of Navajo sheep.

The average body weight for all crossbred rams in 1949 was eight pounds less than the average weight in 1948. This is believed to be due to differences in feed conditions and management in the two years. Average scores for most traits were slightly better in 1949 than they were in 1948.

Group no.	No. of rams	Body weight (pounds)	Face covering (score)	Type (score)	Condition (score)	Color (score)	Outer-coat (score)
1	14	112.3	2.33	2.89	2.64	1.36	2.24
2	15	125.5	2.48	2.08	2.24	1.60	2.08
3	19	130.4	2.54	2.10	1.92	1.21	2.14
6	36	125.1	2.71	2.31	2.30	1.28	2.80
7	18	123.7	2.73	2.35	2.34	1.50	3.08
8	4	123.5	2.97	2.09	2.09	2.00	2.17
9	6	128.0	2.33	1.96	2.02	1.30	2.30
Total and Averages							
All crossbred rams (1949)	98	126.04	2.63	2.21	2.20	1.38	
Navajo rams (1948)	6	115.2	2.23	3.20	2.96	1.17	
All crossbred rams (1948)	101	134.13	2.76	2.74	2.33	1.35	

WOOL PRODUCTION OF YEARLING NAVAJO AND CROSSBRED EWES

All sheep were shorn during the period April 24 to 27, whereas in previous years the shearing has been done in June. Grease fleece weights of yearling ewes, after being adjusted to a 12 months' basis, were somewhat lighter than in 1948, but had a lower shrinkage. Clean fleece weights were adjusted to a 12 percent moisture content, therefore are slightly higher than the 1948 fleece weights which were reported on a bone dry basis.

Crossbred ewes in groups 2, 3, 6, 7, 8, and 9 produced an average of between four and five pounds of clean wool. The first cross Columbia x Navajo ewes of group 3 had the highest average clean fleece weight of 4.85 pounds, and the first cross Romney x Navajo ewes of group 2 had the lowest average fleece weight. Clean fleece weights of the Lincoln cross ewes and the Cotswold cross ewes of groups 6 and 7, closely approached that of the Columbia crossbreds, and slightly exceeded the averages of groups 8 and 9.

The average fiber diameters of all groups were noticeably less in 1949 than in 1948, which means that the fibers were finer at the shorn end of the staple, where they were cross-sectioned. In 1949 the fleece samples for fineness determination were taken during the early part of April, and therefore would reflect the full effect of a lower plane of nutrition during the winter months. In 1948 and previous years fleece samples were taken during the early part of June, after the sheep had been on green feed for a period of 30 to 40 days. This may not account fully for the differences in fiber diameter between 1948 and 1949, but it is believed to have been an important factor.

Average staple length of all groups was less in 1949 than it was in 1948. The Lincoln and Cotswold crossbreds had the longest staple, and the Romney cross had the shortest staple.

The percentages of kemp and other medullated fibers were negligible for all groups.

WOOL PRODUCTION OF YEARLING NAVAJO AND CROSSBRED EWES

Group No.	Pen No.	No. of ewes	Fleece weight		Fineness at side		Staple length (cms.)	Kemp (%)	Other med. fibers (%)
			Grease (lbs.)	Clean* (lbs.)	Diameter (microns)	Grade			
1	1	19	5.90	3.76	25.9	58's	9.8	0.44	1.93
	2	12	5.60	3.54	26.3	58's	11.4	1.14	3.83
	3	16	5.83	3.80	26.1	58's	10.4	.24	3.71
	4	8	5.36	3.51	25.7	58's	10.8	.00	2.51
Total and Averages		55	5.73	3.69	26.0	58's	10.5	.47	2.95
2	W12	12	6.77	4.24	24.7	60's	9.8	0.00	0.20
	W13	8	6.30	4.17	25.4	60's	9.5	.00	.80
	W14	13	6.31	4.26	25.3	60's	9.3	.00	.40
	W15	14	6.63	4.26	25.9	60's	9.5	1.10	.80
Total and Averages		47	6.52	4.24	25.3	60's	9.5	.30	.50
3	W7	15	8.12	5.03	25.1	60's	9.8	0.00	0.40
	W8	6	7.82	5.18	23.0	62's	10.1	.40	6.80
	W9	12	7.45	4.60	23.8	62's	10.1	.00	1.40
	W10	13	7.16	4.75	24.0	62's	10.6	.10	.60
	W11	14	7.22	4.83	24.4	60's	10.4	.00	.60
Total and Averages		60	7.54	4.85	24.2	60's	10.2	.10	.60
6	W1	25	7.04	4.66	25.0	60's	11.0	0.00	0.80
	W2	30	7.09	5.00	25.7	58's	12.0	.00	.50
	W3	15	6.97	4.64	25.4	60's	11.2	.00	.70
	W4	23	6.84	4.51	25.3	60's	11.1	.00	.40
Total and Averages		93	7.00	4.73	25.4	60's	11.4	.00	.60
7	W5	18	7.52	5.14	25.2	60's	12.8	0.00	1.50
	W6	15	6.87	4.41	24.9	60's	11.1	.00	1.30
Total and Averages		33	7.23	4.81	25.0	60's	12.0	.00	1.40
8	W16	2	10.03	6.65	22.9	62's	10.1	0.00	0.00
	W17	14	6.64	4.33	25.5	60's	10.6	.10	1.30
Total and Averages		16	7.06	4.64	25.1	60's	10.4	.10	1.10
9	W18	4	6.40	4.54	26.3	58's	10.4	0.00	0.00
	W19	7	6.77	4.46	26.0	58's	11.6	.00	6.70
Total and Averages		11	6.63	4.49	26.1	58's	11.1	.00	4.30

*Estimated clean fleece weights adjusted for 12 percent moisture content.

WOOL PRODUCTION OF YEARLING NAVAJO AND CROSSBRED RAMS

Fleece weights of the yearling rams were adjusted in the same manner as those of the yearling ewes. Average clean wool production of all groups except group 9, exceeded six pounds. The Cotswold cross rams of group 7 ranked highest with an average of 7.18 pounds of clean wool.

The Cotswold crossbreds had the coarsest fleeces, with the longest staple. The Columbia crossbreds of group 3 and the full-blood Navajo rams were similar in average fiber diameter, being equivalent to the grade of 56's, while all other groups graded 50's or coarser.

Fleeces of the yearling rams contained no kemp and but few other medullated fibers.

Group no.	No. of rams.	Fleece weight		Fineness at side		Staple length (cms.)	Kemp (%)	Other med. fibers (%)
		Grease (lbs.)	Clean* (lbs.)	Diameter (microns)	Grade			
1	14	6.43	4.30	28.8	56's	11.6	0.0	0.08
2	15	8.97	6.09	31.2	50's	11.3	.0	.14
3	19	9.36	6.30	29.0	56's	11.7	.0	1.29
6	38	9.78	6.52	31.4	50's	13.0	.0	.55
7	18	9.48	7.18	31.7	48's	13.3	.0	.60
8	4	8.85	5.43	30.8	50's	10.7	.0	.54
9	7	8.54	6.18	30.0	50's	12.5	.0	.29
Total and Averages	115	9.04	6.20	30.6	50's	12.4	.0	.65

*Estimated clean fleece weights adjusted for 12 percent moisture content.

GRADING AND SORTING THE FLEECES OF WOOL

In connection with the work of project RM-a-427-4 the fleeces of all sheep at this station, except those from the purebred rams, were individually graded and sorted during the period from May 2 to 23. This work was done by two commercially trained wool sorters of the Wool Division, Production and Marketing Administration, U. S. Department of Agriculture.

At shearing time each fleece was wrapped in cheesecloth and identified with a cloth tag bearing the ear tag number of the sheep from which it was shorn. The wrapping of fleeces in cheesecloth was done to prevent loss of tags and pieces of wool, and thereby assure greater accuracy to the weights of fleece sorts.

The various main sorts and off sorts of each fleece were individually weighed in grams and recorded on special forms. As a control measure the weights of main sorts and off sorts of each fleece were totaled on an adding machine, and the combined weight of all sorts was checked against the weight of the whole fleece before it was sorted. By following this procedure with each individual fleece as sorted, errors due to loss of wool at the sorting tables or in weighing the sorts were held to a minimum.

The weights of the main sorts and off sorts of individual fleeces, when properly analyzed, will provide valuable information concerning the variation in commercial qualities of wool within and between fleeces from sheep of the same breeding group. Also the wool production of the various breeding groups can be compared in a more precise manner. With the wool clip bagged according to commercial grades and sorts it becomes possible to accurately determine clean yields and market values of the wool. All of this information is useful as an aid in the selection and mating of the sheep for wool improvement. When such a program is carried out over a period of years the actual progress made in improving uniformity of grade within and between fleeces can be assessed.

Fleece grades as determined by commercial sorters are considerably lower than those determined by the laboratory method, which is to be expected. Commercial grading and sorting is done by "sight and feel" and is strongly influenced by crimp, staple length, and amount of coarse fibers. On the other hand, the laboratory method of determining the grade of the wool is based on average fiber diameter. The Navajo and crossbred wools are considerably finer in average fiber diameter than they appear to the eye. As the wools are improved in uniformity of fiber diameter and fiber length, the differences in grade as determined by the two methods will become less.

FLEECE GRADES, WEIGHTS, AND PERCENTAGES OF MAIN SORTS OF YEARLING AND MATURE NAVAJO EWES AND RAMS

Age and Sex	Fleece grade	No. of fleeces	Percentage of main sorts	Fleece weights (lbs.)
Yearling ewes	3/8 blood	1	72.30	2.96
	1/4 blood	5	78.53	5.03
	Low 1/4 blood	19	70.23	5.24
	Common	18	65.21	5.26
	Braid	8	67.72	5.39
	Low braid	5	76.18	6.76
Total and Averages		56	69.53	5.35
Yearling rams	3/8 blood	2	43.93	4.53
	1/4 blood	5	70.97	5.96
	Low 1/4 blood	3	91.26	5.72
	Common	2	80.59	7.11
	Braid	1	96.64	5.36
	Low braid	0	.00	.00
Total and Averages		13	76.08	5.82
Mature ewes	1/4 blood	38	85.10	3.96
	Low 1/4 blood	80	81.84	4.90
	Common	106	82.25	5.24
	Braid	88	81.56	5.91
	Low braid	59	83.48	5.87
Total and Averages		371	82.42	5.29
Mature rams	1/4 blood	0	0.00	0.00
	Low 1/4 blood	0	.00	.00
	Common	4	83.70	7.67
	Braid	2	98.63	6.59
	Low braid	0	.00	.00
Total and Averages		6	88.22	7.30

In 1949 the fleeces of all Navajo sheep used in the breeding program of the laboratory were commercially graded and sorted for the first time. The Navajo fleeces were especially difficult to sort because of the variation in fiber length and diameter, and lack of character in the wool. Typical Navajo fleeces contain a mixture of fine, undercoat fibers and long, coarse, straight, outercoat fibers. The proportion and length of the outercoat fibers varies within and between fleeces, but is generally highest in the britch wool. Results of the wool sorting provide some measure of the improvement in fleece quality and uniformity that has been accomplished by selective breeding of the sheep.

Fleeces of the yearling Navajo ewes graded predominately Low 1/4 blood and Common, and fleeces of these grades were average with respect to weight and percentages of main sorts.

Fleece grades of Common, Braid, and Low 1/4 blood were most frequent for mature Navajo ewes. Fleece weights were highest for fleeces grading Braid and Low braid. The percentages of main sorts were in excess of 80 percent for fleeces of all grades.

The fleeces of yearling rams graded mainly 1/4 blood and Low 1/4 blood, while the fleeces of mature rams graded either Common or Braid. Fleeces from both yearling and mature rams, in the grade of Common, were heaviest in weight.

Fleece weights of yearling ewes and rams represent about 11 months' growth of wool, and fleeces from mature ewes and rams were 10 months' growth.

FLEECE GRADES, WEIGHTS, AND PERCENTAGES OF MAIN SORTS OF MATURE CROSSBRED EWES AND RAMS

Age and Sex	Fleece grade	No. of fleeces	Percentage of main sorts	Fleece weights (lbs.)
Ewes	1/2 blood	2	86.47	4.51
	3/8 blood	16	83.54	4.92
	1/4 blood	103	79.41	5.78
	Low 1/4 blood	252	78.27	6.26
	Common	217	78.12	6.90
	Braid	83	80.32	7.52
	Low braid	26	78.88	7.67
Total and Averages		699	78.78	6.56
Rams	Low 1/4 blood	4	94.07	9.27
	Common	2	97.48	10.34
	Braid	3	96.44	10.38
Total and Averages		9	95.75	9.88

Fleeces of the mature crossbred ewes and rams graded predominately Low 1/4 blood and Common. Fleeces of these grades were average with respect to weight and percentages of main sorts. Fleece weights of the mature crossbred sheep represent approximately 10 months' of wool growth.

FLEECE WEIGHTS AND PERCENTAGES OF MAIN SORTS IN RELATION TO FLEECE GRADES OF CROSSBRED YEARLING EWES AND RAMS

The following table shows the number of fleeces of each grade, with average percentages of main sorts and average fleece weights for crossbred yearling ewes and rams of each breeding group. Fleece weights represent approximately 11 months' of wool growth.

In group 2, (Romney x Navajo), the fleeces of both ewes and rams graded mainly 1/4 blood and Low 1/4 blood. Fleece weights were highest for fleeces grading Common and Low 1/4 blood. The percentages of main sorts decreased progressively from the grades of 3/8 blood or 1/4 blood to Braid.

In group 3 (Columbia x Navajo) fleeces grading 1/4 blood and Low 1/4 blood were most numerous. Here also fleece weights were highest for the grades of Common and Low 1/4 blood, but there was no consistent relationship between the percentages of main sorts and the grades of the fleeces.

Fleeces of the Lincoln cross ewes and rams (group 6) graded chiefly Low 1/4 blood and Common, while the grades of Common and Braid were more frequent for the Cotswold cross ewes and rams of group 7. In both of these groups the fleeces grading Braid were heaviest in weight.

Fleeces of Low 1/4 blood predominated for the ewes of groups 8 and 9. Ram fleeces were either 1/4 blood or Low 1/4 blood. In general the heaviest fleece weights were associated with the coarsest grades.

Ram fleeces averaged 28 to 50 percent heavier than ewe fleeces.

[illegible] RAMS

[illegible] fleeces [illegible] fleece [illegible] each breeding group. Fleece weights represent [illegible]ly 11 months' of wool growth.

In group 4, (Romney x Navajo), the fleeces of both ewes and rams graded chiefly 1/4 blood and Low 1/4 blood. Fleece weights were highest for fleeces grading Common and Low 1/4 blood. The percentages of main sorts decreased progressively from the grades of 3/8 blood or 1/4 blood to Braid.

In group 5 (Columbia x Navajo) fleeces grading 1/4 blood and Low 1/4 blood were most numerous. Here also fleece weights were highest for the grades of Common and Low 1/4 blood, but there was no consistent relationship between the percentages of main sorts and the grades of the fleeces.

Fleeces of the Lincoln cross ewes and rams (group 6) graded chiefly Low 1/4 blood and Common, while the grades of Common and Braid were more frequent for the Cotswold cross ewes and rams of group 7. In both of these groups the fleeces grading Braid were heaviest in weight.

Fleeces of Low 1/4 blood predominated for the ewes of groups 8 and 9. Ram fleeces were either 1/4 blood or Low 1/4 blood. In general the heaviest fleece weights were associated with the coarsest grades.

Ram fleeces averaged 25 to 50 percent heavier than ewe fleeces.

FLEECE GRADES, WEIGHTS, AND PERCENTAGES OF MAIN SORTS OF CROSSBRED YEARLING EWES AND RAMS CLASSIFIED BY BREEDING GROUPS

Group no.	Fleece grade	No. of ewe fleeces	Percentage of main sorts	Fleece weights (lbs.)	No. of ram fleeces	Percentage of main sorts	Fleece weights (lbs.)
2	3/8 blood	1	89.05	5.57	0	0.00	0.00
	1/4 blood	15	71.03	5.49	8	91.64	7.90
	Low 1/4 blood	19	66.06	6.07	3	83.33	8.88
	Common	9	64.19	6.45	4	79.17	10.80
	Braid	2	57.63	5.31	0	.00	.00
Total and Averages		46	67.23	5.92	15	85.90	8.87
3	3/8 blood	3	81.15	6.63	1	76.47	6.80
	1/4 blood	19	75.34	6.69	8	81.05	9.30
	Low 1/4 blood	25	71.85	7.14	2	77.98	10.90
	Common	6	62.68	7.61	2	84.12	11.65
	Braid	4	52.54	7.29	2	93.38	7.55
Total and Averages		57	70.94	7.02	15	82.18	9.43
6	1/4 blood	2	64.96	5.08	4	92.55	7.52
	Low 1/4 blood	34	63.52	6.14	10	87.55	9.16
	Common	40	53.08	6.50	12	88.16	9.71
	Braid	17	57.59	6.98	7	89.14	10.13
Total and Averages		93	57.79	6.42	33	88.58	9.37
7	1/4 blood	1	69.62	6.78	0	0.00	0.00
	Low 1/4 blood	8	64.07	7.07	2	85.71	8.75
	Common	14	61.30	6.46	7	83.76	8.68
	Braid	8	65.22	7.16	8	86.81	9.10
	Low braid	2	68.09	7.71	0	.00	.00
Total and Averages		33	63.70	6.86	17	85.49	8.89
8	1/4 blood	2	55.80	5.95	2	90.91	8.80
	Low 1/4 blood	7	65.93	6.34	2	84.00	7.50
	Common	4	63.40	6.23	0	.00	.00
	Braid	2	53.97	7.17	0	.00	.00
Total and Averages		15	62.17	6.37	4	88.10	8.15
9	1/4 blood	1	25.30	4.23	3	82.16	7.10
	Low 1/4 blood	8	64.89	5.64	3	84.34	8.13
	Common	2	75.29	6.80	0	.00	.00
Total and Averages		11	64.51	5.72	6	83.46	7.62
All groups	3/8 blood	4	82.89	6.37	1	76.47	6.80
	1/4 blood	40	71.45	6.06	25	86.94	8.27
	Low 1/4 blood	101	66.51	6.42	22	85.43	9.06
	Common	75	57.84	6.57	25	85.70	10.14
	Braid	33	58.68	6.97	17	89.10	9.91
	Low braid	2	68.09	7.70	0	.00	.00
Total and Averages		255	63.79	6.49	90	86.53	9.03

PERCENTAGES OF MAIN SORTS AND OFF SORTS IN FLEECES OF NAVAJO EWES AND RAMS

The percentages of the main sorts and off sorts obtained from the fleeces of the Navajo sheep are summarized in the following table by age and sex of the sheep. In general, the wool grading 3/8 blood, 1/4 blood, and Low 1/4 blood was the most improved with respect to uniformity in length and diameter of fibers. The wool grading Common, Braid, and Low braid was the more typical Navajo wool, with higher content of outercoat fibers. Wool of the low grades was both longer and coarser than the wool grading 3/8 blood to Low 1/4 blood. The Braid and Low braid was mostly from the britch and rear parts of fleeces.

The fleeces of the mature rams appear to be an exception to the general relationship between grade of wool and proportion of outercoat fibers. Although the fleeces of these rams contained high percentages of wool grading Common or Braid, the wool was of a much more uniform type than wool from Navajo ewes of similar grades.

The fleeces of both the mature ewes and the mature rams produced in excess of 80 percent of main sorts, grading predominately Low 1/4 blood, Common, Braid, and Low braid. The fleeces of the yearling ewes and rams had higher percentages of wool grading 3/8 blood, 1/4 blood, and Low 1/4 blood than fleeces from the mature sheep, and ram fleeces contained more wool of these grades than did the ewe fleeces. These differences reflect the effect of breeding and intensity selection practiced.

Tender wool was found only in the fleeces of some yearling rams. The reason for this is not clear as these rams were fed whole oats and a good quality of alfalfa hay throughout the winter months, whereas the yearling and mature ewes were maintained on the range with no supplemental feeding except that they had free access to a mixture of cottonseed meal, bone meal and salt.

All belly wool from yearling and mature rams and most of the belly wool from yearling and mature ewes had good staple length and therefore was classified with the main sorts, unless it was stained.

The high percentage of burry wool for the yearling ewes reduced the proportion of main sorts substantially which emphasizes the importance of eradicating burrs from the fall and winter ranges, and especially around stock watering tanks.

PERCENTAGES OF SORTS OF NAVAJO FLEECES BY AGE AND SEX OF SHEEP

	Sorts expressed as percentage of total wool for each class of sheep -			
Description of Sort	Yearling ewes	Yearling rams	Mature ewes	Mature rams
MAIN SORTS				
Matchings				
3/8 blood (56's-58's)	.67	4.22	0.18	0.00
1/4 blood (50's)	12.73	29.19	7.27	.00
Low 1/4 blood (46's-48's)	13.04	16.57	13.85	.47
Common (44's)	15.23	14.15	23.79	43.34
Braid (40's)	10.70	10.28	15.21	25.78
Low braid (36's)	16.95	1.57	22.15	18.34
TOTAL MAIN SORTS	69.32	75.98	82.45	87.93
OFF SORTS				
Tender				
1/4 blood and finer	0.00	7.53	0.00	0.00
Low 1/4 blood	.00	1.90	.00	.00
Total	.00	9.43	.00	.00
Belly				
1/4 blood and finer	0.18	0.00	0.08	0.00
Low 1/4 blood	1.40	.00	1.10	.00
Common and coarser	1.04	.00	1.23	.00
Total	2.62	.00	2.41	.00
Burry				
1/4 blood and finer	0.27	4.37	0.03	0.00
Low 1/4 blood	3.24	.00	1.35	.00
Common and coarser	12.17	.46	5.60	1.53
Total	15.68	4.83	6.98	1.53
Stained				
1/4 blood and finer	0.07	5.08	0.03	0.00
Low 1/4 blood	3.53	.57	1.50	.00
Common and coarser	6.15	3.00	5.43	10.29
Total	9.75	8.65	6.96	10.29
Paint				
1/4 blood and finer	0.14	0.19	0.10	0.00
Low 1/4 blood	.58	.25	.23	.00
Common and coarser	1.00	.23	.64	.00
Total	1.72	.67	.97	.00
Tags	0.91	0.44	0.15	0.25
TOTAL OFF SORTS	30.67	24.02	17.55	12.07
TOTAL POUNDS OF WOOL	299.44	75.60	1962.82	43.84
TOTAL NUMBER OF FLEECES	56	13	371	6

PERCENTAGES OF MAIN SORTS AND OFF SORTS IN FLEECES OF CROSSBRED EWES AND RAMS

The percentages of main sorts and off sorts in the fleeces of 1193 crossbred sheep are summarized in the following table by age and sex classes. Ram fleeces contained higher percentages of main sorts than the ewe fleeces, and the fleeces of mature ewes and rams had higher percentages of main sorts than the fleeces of yearling ewes and rams.

The percentages of main sorts in fleeces of yearling rams, yearling ewes, and mature ewes were considerably higher in 1949, than in 1948. Differences between years reflect variation in the work of the sorters and environmental effects.

In 1949 there was no tender, off sort wool from yearling ewes, mature ewes, or mature rams, while the yearling rams had only 0.45 percent. Most of the belly wool was classified with the main sorts, whereas in 1948 the percentage of belly, off sort wool amounted to about 10 percent. This difference in amount of belly, off sort wool between the two years was the result of sorting. The percentage of burry wool was higher for yearling ewes, but lower for the other classes of sheep in 1949.

The percentages of off sorts probably can be reduced still further through improved management of the sheep, and eradication of burrs on the fall and winter range.

PERCENTAGES OF SORTS OF CROSSBRED FLEECES BY AGE AND SEX OF SHEEP

	Sorts expressed as percentage of total wool for each class of sheep -			
Description of Sorts	Yearling ewes	Yearling rams	Mature ewes	Mature rams
MAIN SORTS				
Matchings				
1/2 blood (60's-62's)	0.20	0.00	0.11	0.00
3/8 blood (56's-58's)	2.41	1.76	2.19	.00
1/4 blood (50's)	15.17	20.67	13.70	10.18
Low 1/4 blood (46's-48's)	18.63	21.85	17.28	19.66
Common (44's)	17.49	21.40	25.62	31.89
Braid (40's)	6.63	16.45	10.29	22.45
Low braid (36's)	3.43	4.29	9.48	11.41
TOTAL MAIN SORTS	63.96	86.42	78.67	95.59
OFF SORTS				
Tender				
1/4 blood and finer	0.00	0.32	0.00	0.00
Low 1/4 blood	.00	.13	.00	.00
Total	.00	.45	.00	.00
Belly				
1/4 blood and finer	0.86	0.00	0.49	0.00
Low 1/4 blood	.16	.00	1.69	.00
Common and coarser	.12	.00	.63	.00
Total	1.14	.00	2.81	.00
Burry				
1/4 blood and finer	2.58	0.97	0.45	0.44
Low 1/4 blood	8.89	1.34	3.30	.56
Common and coarser	11.89	.87	5.44	.06
Total	23.36	3.18	9.19	1.06
Stained				
1/4 blood and finer	0.85	3.01	0.37	0.54
Low 1/4 blood	3.78	2.78	2.72	1.12
Common and coarser	3.27	1.86	3.96	.32
Total	7.90	7.65	7.05	1.98
Paint				
1/4 blood and finer	0.37	0.39	0.44	0.44
Low 1/4 blood	1.10	.45	.98	.49
Common and coarser	.72	.63	.53	.15
Total	2.19	1.47	1.95	1.08
Tags	1.45	0.83	0.33	0.29
TOTAL OFF SORTS	36.04	13.58	21.33	4.41
TOTAL POUNDS OF WOOL	663.21	941.09	5234.55	88.92
TOTAL NUMBER OF FLEECES	281	106	797	9

PERCENTAGES OF MAIN SORTS AND OFF SORTS OF CROSSBRED YEARLING EWES BY BREEDING GROUPS

Data on the percentages of main sorts and off sorts obtained from the fleeces of crossbred yearling ewes are summarized in the following table, by breeding groups.

The percentages of main sorts were comparatively low for the yearling crossbred ewes because of relatively high percentages of burry wool. There was no tender wool, however, and the percentages of other off sorts were low.

The main sorts for Romney x Navajo and Columbia x Navajo ewes, groups 2 and 3, respectively, were principally 1/4 blood and Low 1/4 blood. The Lincoln cross ewes and Cotswold cross ewes, of groups 6 and 7, produced the highest percentages of wool grading Low 1/4 blood and Common. In groups 8 and 9 the highest percentages of main sorts were for the grades of Low 1/4 blood and Common.

PERCENTAGES OF SORTS OF CROSSBRED YEARLING EWE FLEECES
CLASSIFIED BY BREEDING GROUPS

Description of Sorts	Percentages of sorts for breeding groups -						
	2 (%)	3 (%)	6 (%)	7 (%)	8 (%)	9 (%)	All groups (%)
MAIN SORTS							
Matchings							
1/2 blood (60's-62's)	0.00	0.04	0.00	0.00	0.00	0.00	0.01
3/8 blood (56's-58's)	4.52	6.47	.07	.00	.78	.00	2.38
1/4 blood (50's)	27.46	26.52	7.20	2.49	9.14	5.93	14.65
Low 1/4 blood (46's-48's)	15.79	25.18	15.48	14.19	22.21	27.75	18.56
Common (44's)	15.43	5.75	22.52	28.04	16.66	21.24	17.65
Braid (40's)	2.63	3.59	9.38	12.56	8.43	5.78	7.10
Low braid (36's)	2.00	3.09	3.10	6.05	4.99	3.75	3.45
TOTAL MAIN SORTS	67.83	70.64	57.75	63.33	62.21	64.45	63.80
OFF SORTS							
Belly							
1/4 blood and finer	0.73	0.93	0.17	0.16	4.70	4.58	0.87
Low 1/4 blood	.00	.00	.33		.00	.00	.12
Common and coarser	.16	.00	.12		.00	.70	.10
Total	.89	.93	.62	.16	4.70	5.28	1.09
Burry							
1/4 blood and finer	4.39	3.90	.55	.13	2.89	4.35	2.22
Low 1/4 blood	6.98	7.35	11.04	7.38	10.33	10.90	8.93
Common and coarser	8.26	6.48	18.30	14.32	11.27	3.72	12.28
Total	19.63	17.73	29.89	21.83	24.49	18.97	23.43
Stained							
1/4 blood and finer	2.00	1.48	0.27	0.00	1.14	0.00	0.85
Low 1/4 blood	3.95	4.02	3.17	3.95	3.04	7.80	3.78
Common and coarser	2.14	2.77	3.79	5.38	1.66	1.32	3.27
Total	8.09	8.27	7.23	9.33	5.84	9.12	7.90
Paint							
1/4 blood and finer	0.62	0.59	0.19	0.06	0.28	0.21	0.34
Low 1/4 blood	1.34	.78	1.29	1.84	.31	1.02	1.18
Common and coarser	.20	.21	1.03	2.01	.74	.36	.79
Total	2.16	1.58	2.51	3.91	1.33	1.59	2.31
Tags	1.40	0.85	2.00	1.44	1.43	0.59	1.47
TOTAL OFF SORTS	32.17	29.36	42.25	36.67	37.79	35.55	36.20
TOTAL POUNDS OF WOOL	273.68	400.48	597.84	224.34	95.50	62.95	1654.79
TOTAL NUMBER OF FLEECES	46	57	91	33	15	10	252

PERCENTAGES OF MAIN SORTS AND OFF SORTS OF CROSSBRED YEARLING RAMS BY BREEDING GROUPS

The percentages of main sorts and off sorts in the fleeces of crossbred yearling rams are summarized in the following table by breeding groups. The fleeces of all groups of yearling rams had more than 80 percent of main sorts, and the average for breeding groups 2 to 9 was 86.13 percent.

Wool of 1/4 blood fineness predominated in the fleeces of the Romney x Navajo rams of group 2, while the Columbia x Navajo rams in group 3 had the highest percentage of 3/8 blood wool. The Lincoln cross rams and Cotswold cross rams, groups 6 and 7, had high percentages of wool grading common and Braid. The rams of groups 8 and 9 were the most uniform as to grade of wool, and had the highest percentages of main sorts grading 1/4 blood and Low 1/4 blood, which are the most desired grades. The rams of group 8 were produced by mating Columbia cross rams with Cotswold cross ewes. The matings of group 9 are the reciprocal of those in group 8.

All belly wool was classified with the main sorts owing to its good staple length, and the percentage of burry wool was low for all groups of yearling rams. Only groups 3 and 7 had any tender wool, and the amount was negligible

PERCENTAGES OF SORTS OF CROSSBRED YEARLING RAM FLEECES CLASSIFIED BY BREEDING GROUPS

	Percentages of sorts for breeding groups -						
Description of Sorts	2 (%)	3 (%)	6 (%)	7 (%)	8 (%)	9 (%)	All groups (%)
MAIN SORTS							
Matchings							
3/8 blood (56's-58's)	0.72	7.28	0.13	0.03		0.44	1.47
1/4 blood (50's)	31.13	35.56	11.48	1.07	46.33	35.61	19.72
Low 1/4 blood (46's-48's)	32.09	13.83	19.43	11.46	35.70	35.74	20.62
Common (44's)	14.64	11.51	30.93	31.32	5.57	11.72	22.85
Braid (40's)	5.71	10.46	21.25	33.53	.00	.00	17.06
Low braid (36's)	1.78	3.56	5.30	8.02	.00	.00	4.41
TOTAL MAIN SORTS	86.07	82.20	88.52	85.43	87.60	83.51	86.13
OFF SORTS							
Tender							
1/4 blood and finer	0.00	2.08	0.00	0.00	0.00	0.00	0.36
Low 1/4 blood	.00	.00	.00	.82	.00	.00	.16
Total	.00	2.08	.00	.82	.00	.00	.52
Burry							
1/4 blood and finer	0.47	1.91	0.48	0.00	1.53	1.64	0.75
Low 1/4 blood	1.30	1.14	.99	2.43	1.56	.09	1.31
Common and coarser	.13	.08	1.80	1.52	.00	.00	1.00
Total	1.90	3.13	3.27	3.95	3.09	1.73	3.05
Stained							
1/4 blood and finer	3.39	6.80	1.24	0.05	2.66	7.54	2.75
Low 1/4 blood	1.66	2.43	2.50	4.25	5.85	5.80	3.00
Common and coarser	3.22	1.37	2.20	2.96	.00	.00	2.15
Total	8.27	10.60	5.94	7.26	8.51	13.34	7.90
Paint							
1/4 blood and finer	0.99	0.95	0.16	0.07	0.12	0.63	0.44
Low 1/4 blood	.10	.69	.81	.31	.00	.00	.50
Common and coarser	1.17	.00	.35	1.48	.00	.00	.60
Total	2.26	1.64	1.32	1.86	.12	.63	1.54
Tags	1.50	0.35	0.95	0.68	0.68	0.79	0.86
TOTAL OFF SORTS	13.93	17.80	11.48	14.57	12.40	16.49	13.87
TOTAL POUNDS OF WOOL	132.75	141.42	307.29	151.08	32.66	45.72	810.92
TOTAL NUMBER OF FLEECES	15	15	33	17	4	6	90

SALES OF RAMS DURING 1949

A total of 98 crossbred breeding rams were sold by the laboratory during 1949. Four of therams were purchased by the Instituto Agrepucario Nacional, Guatemala, C. A., to be used in an experimental breeding project for improvement of Indian-owned sheep in the highlands of that country. The remaining 94 rams went to the Navajo Indian Reservation, through sales to individual Indians, traders, and the Navajo Tribal Ram Pastures Project. All of the rams were yearlings except four that were either two or three years of age. These rams were produced from matings in breeding groups 2, 3, 6, 7, 8, and 9, and a few were of the XJ series produced from test pen matings.

Following is a summary of the ram sales by districts of the Navajo Reservation:

District number	Number of ram sales
3	16
5	12
9	25
11*	10
12	14
14	5
16	4
17	7
18	1

*Number includes four rams purchased by the Navajo Tribal Ram Pastures Project.

WOOL SALES

Following is a summary of wool sales during the year covered by this report:

	Raw wool (lbs.)	Scoured wool (lbs.)	Tags (lbs.)
Individual Indians	751	27	50
Indian Service schools	50	200	
Indian traders	7694		508
Totals	8495	227	558